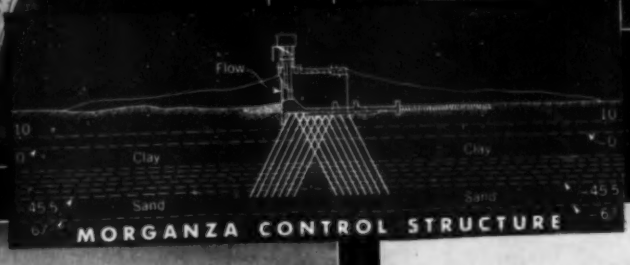
CIVIL ENGINEERING



GIANT MORGANZA FLOOD CONTROL JOB

COMPLETED 3 MONTHS AHEAD OF SCHEDULE!

DRIVING FOUNDATION PILES for the gated portion of Morganza, La., Floodway Control Structure is one of the outstanding pile jobs of the year. Skilled planning of operations and use of two of the largest pile drivers ever built have enabled Raymond to complete this work three months ahead of schedule. Structure is supported on 3,734 precast concrete piles 80 to 118 feet in length—practically all driven on a batter.

AROUND THE WORLD FOUNDED 1897

Design and Construction under Supervision of
COL. CHARLES E. HOLLE, U.S.A., *District Engineer,*
New Orleans District, Corps of Engineers
Department of the Army.

THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Soil Investigations, Pi
and Caisson Foundat
Underpinning, Harbo
and River Improvemen
and Lining of Steel
and Concrete Pipelin
by the Centriline
and Tate Processes.

RAYMOND
CONCRETE PILE CO
140 CEDAR STREET • NEW YORK 6, N. Y.

BRANCH OFFICES in the Principal Cit
of United States and
Central and South America.

Big Yellow Machines on Colorado's Model Turnpike

WHEN you drive between Denver and Boulder, Colorado, over the new toll turnpike, you will be impressed by its long, sweeping curves, easy grades and superb surface. You'll appreciate, too, the saving in time and driving effort as well as the 8-mile shortening in distance. Colorado can be justly proud of this superhighway.

Construction of the turnpike was performed by a number of well-known contractors, including Peter Kiewit Sons' Co., J. H. and N. M. Monaghan, Western Contracting Corporation and Colorado Constructors, Inc. With the first contracts let in late 1950, the job has been carried through in good time.

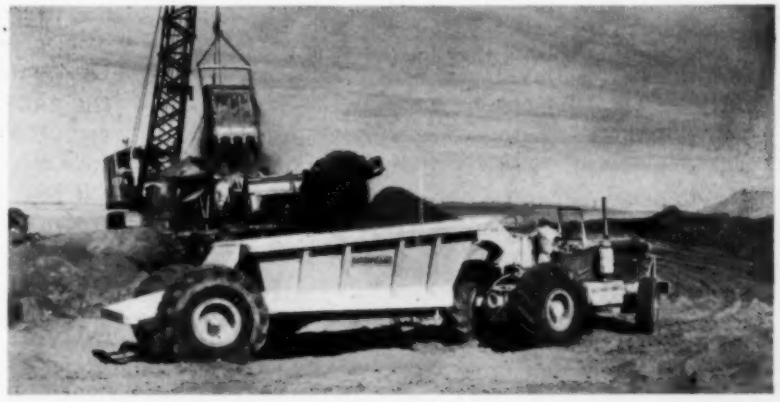
A great part of the earthmoving and grading has been done by "Caterpillar" equipment owned by the various contractors. "Cat" D8, D6 and D4 Tractors, equipped with "Caterpillar" Bulldozers, handled the short-haul work. Over longer distances "Cat" DW20 Tractors, pulling W20 Wagons or No. 20 Scrapers, rolled their big loads fast. Much of the leveling and surface preparation was done by "Caterpillar" No. 12 Motor Graders. And numerous "Caterpillar" Diesel Engines powered shovels and compressors along the route.

As on practically every important highway contract in the nation, the big yellow machines made by "Caterpillar" have contributed to the efficiency and speed of this construction job. Built with the stamina to stand up and take it under the toughest conditions, they keep steadily at work with a minimum of down-time. And when repairs are needed, fast service is always available from "Caterpillar" Dealers.

Good equipment is valuable property in times like these. It's worth taking care of. A few minutes a day spent on proper maintenance pays off in many added hours of profitable work life.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

A "Caterpillar" D8 Tractor and 'Dozer, owned by Peter Kiewit Sons' Co., backfills around a bridge on the Denver-Boulder Turnpike. Lorain dragline in background is powered by a "Cat" D318 Engine.

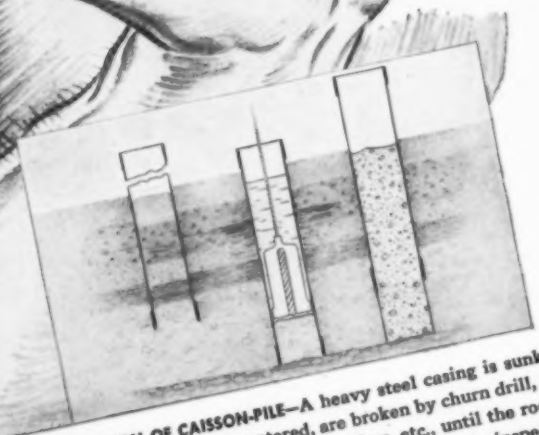


Big loads of fill earth are handled by this "Caterpillar" DW20 Tractor, pulling a W20 Wagon. Owned by Peter Kiewit Sons' Co.

This "Cat" No. 12 Motor Grader, owned by Colorado Constructors, Inc., is finishing a shoulder on the new turnpike, Colorado's only toll road.

CIVIL ENGINEERING, The Magazine of Engineered Construction, April, 1952. Vol. 22, No. 4. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Strength without steel



CONSTRUCTION OF CAISSON-PILE—A heavy steel casing is sunk to rock. Boulders, when encountered, are broken by churn drill, and materials removed by sand pumps, bailers, etc., until the rock is exposed. If hole is dry, surface of the rock is visually inspected; otherwise, it is tested by the drilling. When cleaned, pipe is filled with concrete, either in the dry or by tremie, and withdrawn.

WESTERN'S CAISSON PILES

IN ADDITION TO THE STEEL SHORTAGE, unusually difficult soil conditions created a problem in constructing the pile foundations for the Warehouse and D Annex Buildings of the Westinghouse Electric Corp. plant in East Pittsburgh.

THE CLAY WHICH EXTENDS from below the fill to just above the rock is interspersed with layers of soft shale; and a water-bearing sand-gravel layer directly overlying the rock made standard types of open caissons impossible. WESTERN, in cooperation with Stone & Webster engineers, solved the problem and saved a large amount of steel by using WESTERN'S all-concrete caisson-piles.

THE CAISSON-PILES were designed for capacities up to 450 tons each. WESTERN installed 191 concrete caisson-piles to complete the first section of this job. Upon completion of the superstructure, WESTERN will install foundations for the second section of the Annex Building. Since the piles rest on the shale bedrock, any possibility of future settlement is eliminated.

DO YOU HAVE A FOUNDATION PROBLEM? WESTERN will be glad to place at your disposal the advice of competent engineers who have handled every type of foundation problem successfully for many years. Ask for brochure illustrating and describing WESTERN piles and services.

COMPLETE FOUNDATIONS FOR EVERY TYPE OF HEAVY CONSTRUCTION. SPECIALISTS IN SHEETPILE AND COFFERDAM WORK.

D Annex and Warehouse Buildings of the Westinghouse Electric Corp. plant in East Pittsburgh.

WESTERN FOUNDATION CORPORATION

308 W. Washington St., Chicago 6, Ill. • 2 Park Avenue, New York 16, N. Y.

in WIRE ROPE, too load strain calls for SPECIALIZED muscles

Everything looks upside down to the three-toed sloth. Unique among animals, he prefers to live his life dangling downward from the top branches of tall trees. Helping him to survive in his topsy-turvy world are highly specialized and powerfully developed rear and forelimb muscles.

In wire rope, too, specialized jobs call for the right kind of muscle. Load strain! Bending fatigue! Shock stress! Abrasion! Each calls for wire rope that best combines the required resistance characteristics.

Complete quality control from ore to finished rope; long experience and specialized know-how—these are your assurance that in Wickwire Rope you always get the proper combination of physical properties for long-lasting, reliable service on your particular job.

For additional information write or phone our nearest sales office.

THE COLORADO FUEL & IRON CORPORATION—Abilene (Tex.) • Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
THE CALIFORNIA WIRE CLOTH CORPORATION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) • New York • Philadelphia

WICKWIRE ROPE
A CF&I PRODUCT

LOOK FOR THE YELLOW TRIANGLE ON THE REEL

WICKWIRE ROPE

CF&I

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

TODAY'S NEWS IN PORTABLES

THE GARDNER-DENVER 600!

IT'S A 600 FROM THE GROUND UP

Here's a brand-new machine that gives you famous Gardner-Denver dependability in a 600 cubic foot portable. Compressor, engine and undercarriage are all specially designed for high capacity performance.

And a FULL 600

Delivers a full 600 cubic feet of air per minute, actual capacity, at 100 pounds pressure. The compressor is an 8 x 6½ x 6, operating at only 1200 r.p.m.

SMOOTH RUNNING

Moderate operating speed and balanced construction minimize vibration.

FULLY WATER-COOLED

Fully water-cooled compressor cylinders assure low discharge temperatures on the hottest day of the year—properly lubricated cold weather starts. Two-stage design insures higher output for all work.

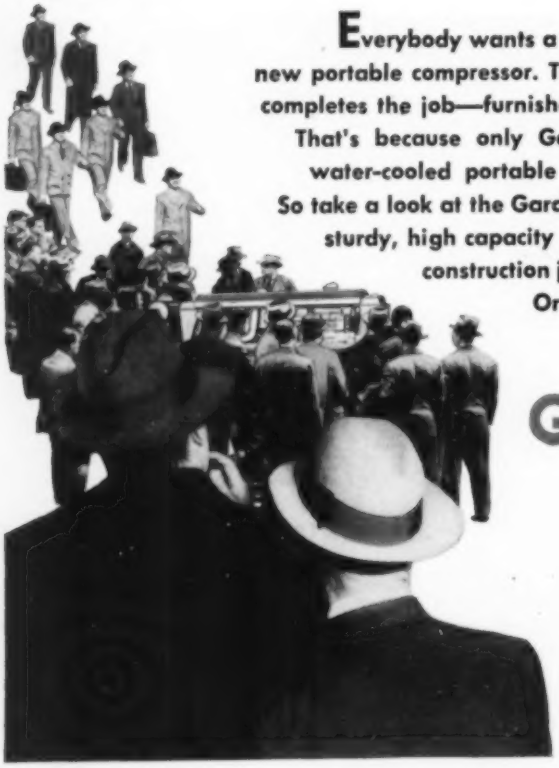
Engineered for Economy

Extra-large valve areas and air passages — properly engineered ratio of low pressure to high-pressure cylinders — are some of the features that raise compressor efficiency—lower operating costs.

RUGGED, STRONG UNDERCARRIAGE

Travels access roads safely—enables you to spot the Gardner-Denver 600 anywhere. Deep oil sumps on both compressor and engine permit off-level operation when necessary.

MORE VALUE FOR YOUR MONEY



Everybody wants a look-see when Gardner-Denver introduces a new portable compressor. They know from experience that a Gardner-Denver completes the job—furnishes low-cost compressed air every single day. That's because only Gardner-Denver makes a two-stage, fully water-cooled portable for all weather, and for any altitude. So take a look at the Gardner-Denver 600 today. See for yourself how this sturdy, high capacity portable can speed your big tunnel and construction jobs. It'll give you new ideas on low bidding. Or write us for the specifications.

SINCE 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS

Like Spring and Baseball

they Go Together

ALL-WHEEL DRIVE

and ALL-WHEEL STEER

CONTROLLED TRACTION—product of exclusive All-Wheel Drive and All-Wheel Steer—makes it easy for an A-W Power Grader to deepen ditches and widen roads. The powerful front drivers ride the shoulder; the rear drivers follow the ditch line, and a beautiful "job of work" is turned out. Yes, All-Wheel Drive and All-Wheel Steer *go together . . . work together* on every job. Why be satisfied with less in your next grader?

AUSTIN-WESTERN COMPANY · *Subsidiary of Baldwin-Lima-Hamilton Corporation* · AURORA, ILLINOIS, U.S.A.

Austin Western

BALDWIN BLH LIMA-HAMILTON

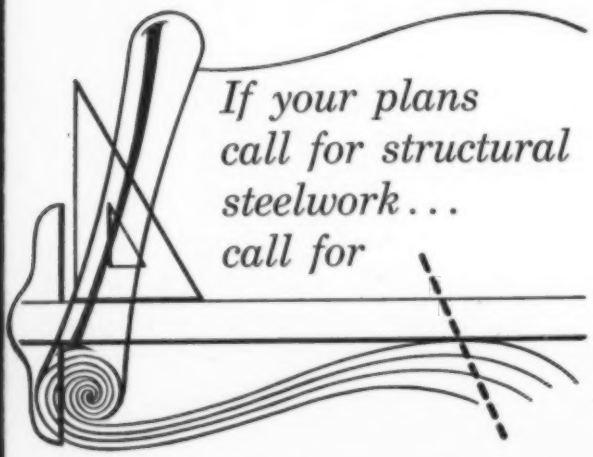
SINCE 1859—BUILDERS OF CONSTRUCTION EQUIPMENT

THE DRAMATIC UPSWEEP of glass and steel that distinguishes Chicago's latest skyscraper apartment building was made possible by the unique steel design and construction that holds the floor-to-ceiling glass walls in place. The steel face of the building consists of horizontal facia plates welded across the spandrel beams, with vertical I-beam mullions on 5-foot, 3-inch spacings running the height of the building.

3,600-Ton Steel Framework for Chicago's Unique Glass House

Owner: 860 Lake Shore Drive Trust.
Architects and Engineers: Mies Van Der Rohe, Pace Associates, and Holsman, Holsman, Klekamp & Taylor, Chicago.

fabricated and erected by AMERICAN BRIDGE



TWO 26-story towers of steel and glass connected at basement and ground floor comprise this ultra-modern 288-apartment structure. The unique design and construction of the vertical mullions and horizontal facia plates made possible the framing that holds the glass walls in place. There are no conventional masonry curtain walls. This imposing building occupies a block-long site along Lake Shore Drive and provides a beautiful view overlooking Lake Michigan on Chicago's swanky North Side within a short drive of the Loop. The 2,842 tons of structural steel and the 856 tons of plate steel for the face of the building were fabricated and erected by American Bridge.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL COMPANY,
GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

Contracting Offices in: AMBRIDGE · ATLANTA · BALTIMORE · BIRMINGHAM · BOSTON · CHICAGO · CINCINNATI · CLEVELAND · DALLAS · DENVER · DETROIT · DULUTH · ELMIRA · GARY · MEMPHIS · MINNEAPOLIS · NEW YORK · PHILADELPHIA · PITTSBURGH · PORTLAND, ORE. · ROANOKE · ST. LOUIS · SAN FRANCISCO · TRENTON
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

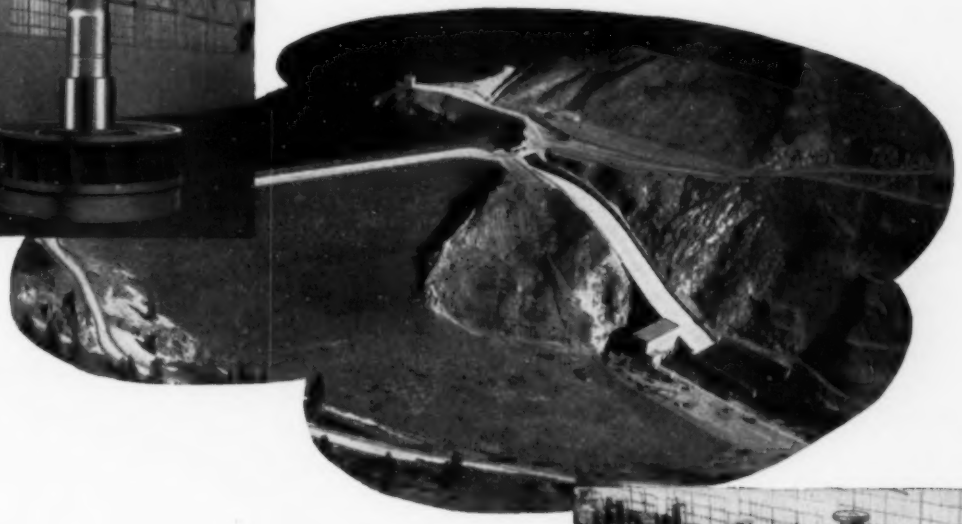
AMERICAN BRIDGE

50 years of "know how" in fabricating and erecting structural steel—your assurance of a better job.

USS

UNITED STATES STEEL

The *"Anderson Ranch"* POWER PROJECT
United States Bureau of Reclamation



hydraulic turbines by **LEFFEL**

Anderson Ranch Dam, located on the Boise River in Idaho, U. S. A., is the highest earth-fill dam in the world. Two Leffel turbines are installed in the Anderson Power Plant which provides power for the surrounding area. The turbines are of the cast steel spiral case, vertical Francis type and each is maximum rated at 28,250 HP, under 324 ft. net head, speed 277 RPM.

When you consider turbines for *your* power project (whether it is a new installation or the expansion of an existing installation) we ask you to keep in mind the services which are offered by Leffel. Our 90 years of experience, our large modern plant, our thorough workmanship — all are ready to serve you.

With a structural height of 456 feet, a base width of 2,650 feet and a crest length of 1,350 feet the Anderson Ranch Dam contains nearly 10,000,000 cubic yards of earth and rock. The reservoir behind the dam will hold 493,200 acre-feet of water.

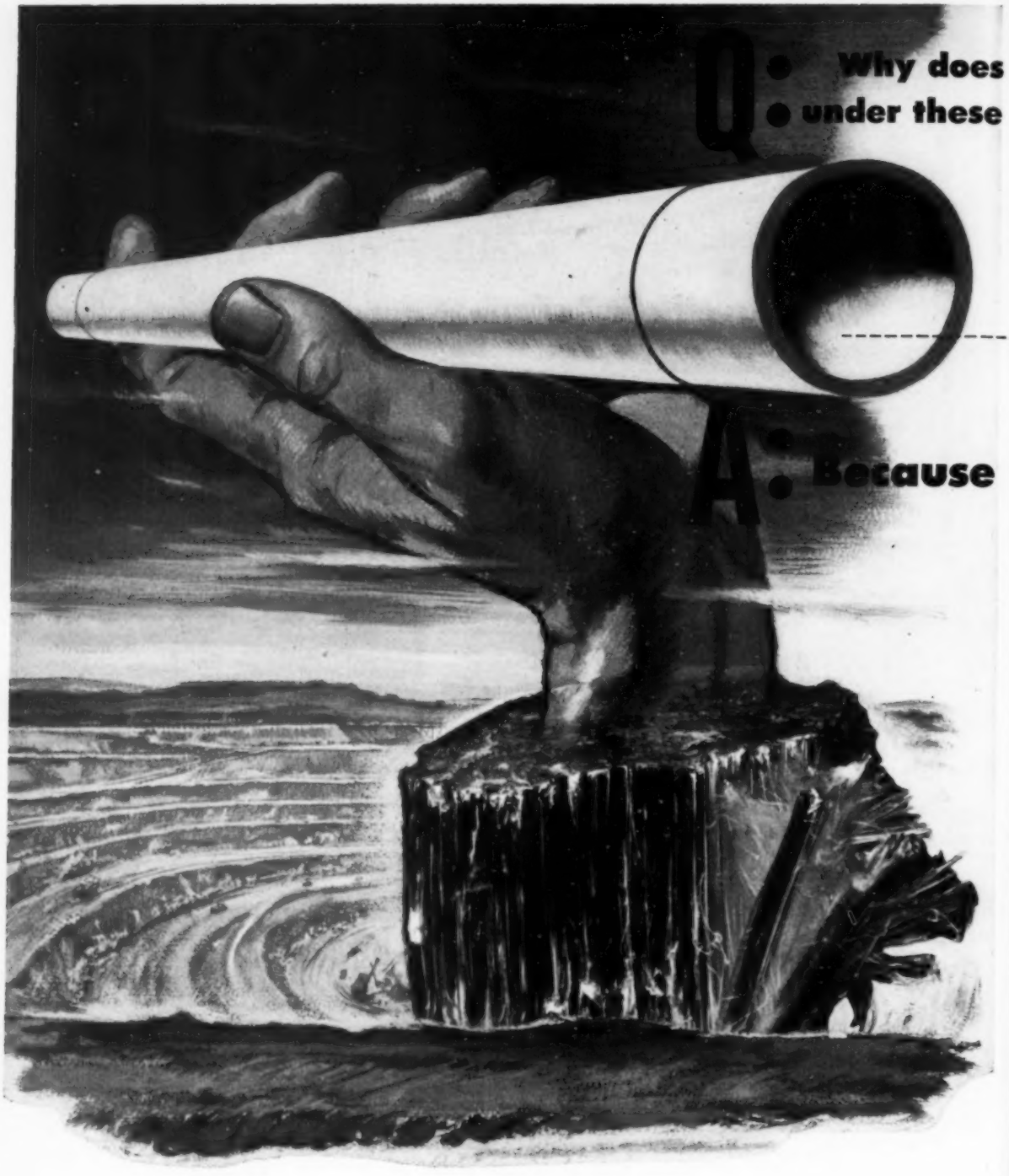
1083

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 90 YEARS



*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE

TRANSITE PIPE last longer West Virginia city streets?

Transite Pipe was first installed in this West Virginia city in 1935. In addition to heavy street traffic, it has withstood soil conditions so destructive that the pipe previously used had a service life of only two to three years. When the Transite main was recently uncovered to insert a tap into the line, the pipe was found in as good condition as the day it was laid!

it's reinforced with ASBESTOS for lasting strength

THERE IS GOOD REASON why Transite* Pressure Pipe—shown in the city street above—has already far exceeded engineers' expectations for the service life of pipe used here:

It's reinforced with tough, strong, indestructible fibers of asbestos—*the mineral that defies time!*

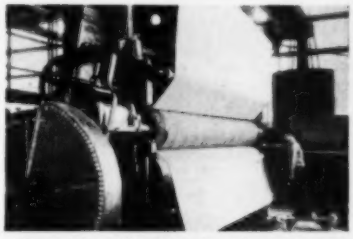
Countless numbers of these remarkably strong asbestos fibers—their tensile strength is comparable to that of steel—are dispersed uniformly throughout every length of Transite Pressure Pipe. This reinforced structure not only contributes to the *initial* strength needed in a pipe designed for use under busy city streets. Equally important, it helps assure the *lasting* strength that enables Transite Pipe to survive continued corrosive attack, year after year . . . to *stay* strong in service under conditions that are highly adverse to ordinary pipe materials.

This quality of lasting strength is one of many important advantages of a pipe engineered with modern water transportation requirements in mind. Transite's Simplex Couplings reduce waterline leakage losses to a minimum, provide flexibility to help relieve the line of soil stresses and traffic loads. Its light weight makes for easier handling and effects substantial savings during installation. Its smooth interior assures a high coefficient of flow (C=140) and, because Transite can never tuberculate, helps keep pumping costs low through the years.

To find out more about how this modern asbestos-cement pipe can help solve your waterline problems and save you money, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS

This photomicrograph shows how the tough, strong asbestos fibers are distributed uniformly throughout the structure of the pipe.



On machines like this, the asbestos-cement-silica mixture is "built up" under heavy pressure into a dense, homogeneous pipe structure.

Transite's flexible Simplex Couplings help relieve the line of excessive flexural stresses—an added safeguard against pipe failures.

asbestos-cement PRESSURE PIPE

UNDER WAY...
Penrose Avenue Bridge, Philadelphia

Construction view of the 56 Monotube-supported piers for this important new bridge over the Schuylkill River—a joint project of the City of Philadelphia and the State of Pennsylvania. Design Engineers: Modjeski and Masters; General Contractor: Foley Brothers, Inc.; Pile Driving Contractor: Fehlhaber Pile Co.

MONOTUBES...

best for holding structures up —and holding costs down!

ALMOST 38 miles of Monotube piles, from 26 to 82 feet long, support the 56 piers (above) for the new Penrose Avenue Bridge, Philadelphia. It's one of the many types of construction where Monotubes are again and again the preferred choice. For with Monotubes, engineers and contractors always stand to gain important advantages . . .

First, Monotube taper-flute, *cold-rolled* construction means *extra* strength, extra structural value that can be utilized in designing for heavy loads, often requiring fewer piles. Moreover, their tapered tubular design makes inspection before concreting rapid and easy for positive assurance of condition after installation.

Secondly, you simply can't match light weight Monotubes for ease of handling, locating and driving . . . nor for simplified field splicing with fast cut-off and minimum waste.

On job after job it adds up to sound foundations with a new low in installation time and cost. Get all the facts on why these gains are possible with Monotubes. Just write to The Union Metal Manufacturing Co., Canton 5, Ohio.

UNION METAL
Monotube Foundation Piles

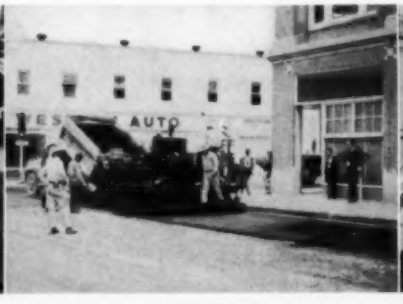
City replaces 38-year-old paving with more of the same

38-year-old Texaco Asphaltic Concrete pavement on William Street, Corpus Christi, Texas. Due principally to utility cuts made over the years, this was one of 39 blocks recently repaved by Corpus Christi.

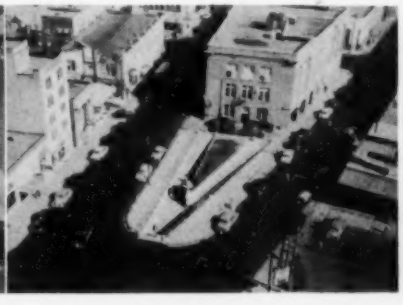
The old pavement was scarified and removed, after which the original foundation was cleaned thoroughly and given an asphalt tack coat. Photo shows street car tracks being removed prior to construction of new pavement.

A leveling course of Texaco Asphaltic Concrete was spread over the old foundation by means of a blade maintainer. Approximately 50 pounds of asphalt mix per square yard was required for this course.

Compaction of the asphaltic concrete leveling course was performed by a pneumatic tired roller exclusively. Chief purpose of the leveling course was to correct the exceptionally high crown of the old streets.



The new Texaco Asphaltic Concrete wearing surface was laid by mechanical paver and compacted by 3-wheel and tandem rollers. J. M. Dellinger, Inc., the contractor, used extra men and equipment to expedite the work.



Peoples and Schatzell Streets, with the City Hall in the triangle. Both these streets were paved with Texaco Asphaltic Concrete in 1913 and were repaved with the same type of construction last year.

Congratulations to
CORPUS CHRISTI, TEXAS,
on its
100th ANNIVERSARY

Two helpful booklets about asphalt paving of all types can be obtained by city officials without charge by writing our nearest office.

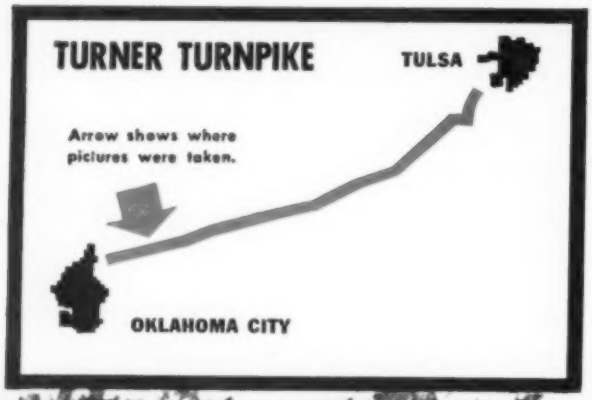
Faithfully yours
50
for Fifty Years

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17
Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO

TEXACO ASPHALT

Turning on the Power on the Turner Turnpike



"Big Red"—the International TD-24—carries the load for contractors on Oklahoma's new superhighway

12,500,000 cubic yards of earth are being moved to build the great new Turner Turnpike—a four-lane, limited access superhighway between Oklahoma City and Tulsa, 88 miles away.

Contractors on the job report that their International TD-24s are moving more dirt per day, because they have more power, more speed and more steer-ability than any other crawler on the market.

As Vernon Pool of Pool Construction Co. says, *"Nothing can beat these TD-24s. We have ten of them on our section of the Turner Turnpike. They out perform any other tractor I've ever seen. Our operators love them.*

"We've had all kinds of tractors, but the next ones I buy will be Internationals, too. One big reason besides their performance is that we always get prompt service from our International Distributor."

Get the low-down on TD-24 superiority from your International Industrial Distributor. Then consider the service he offers you—and you'll be a TD-24 man yourself from then on in!

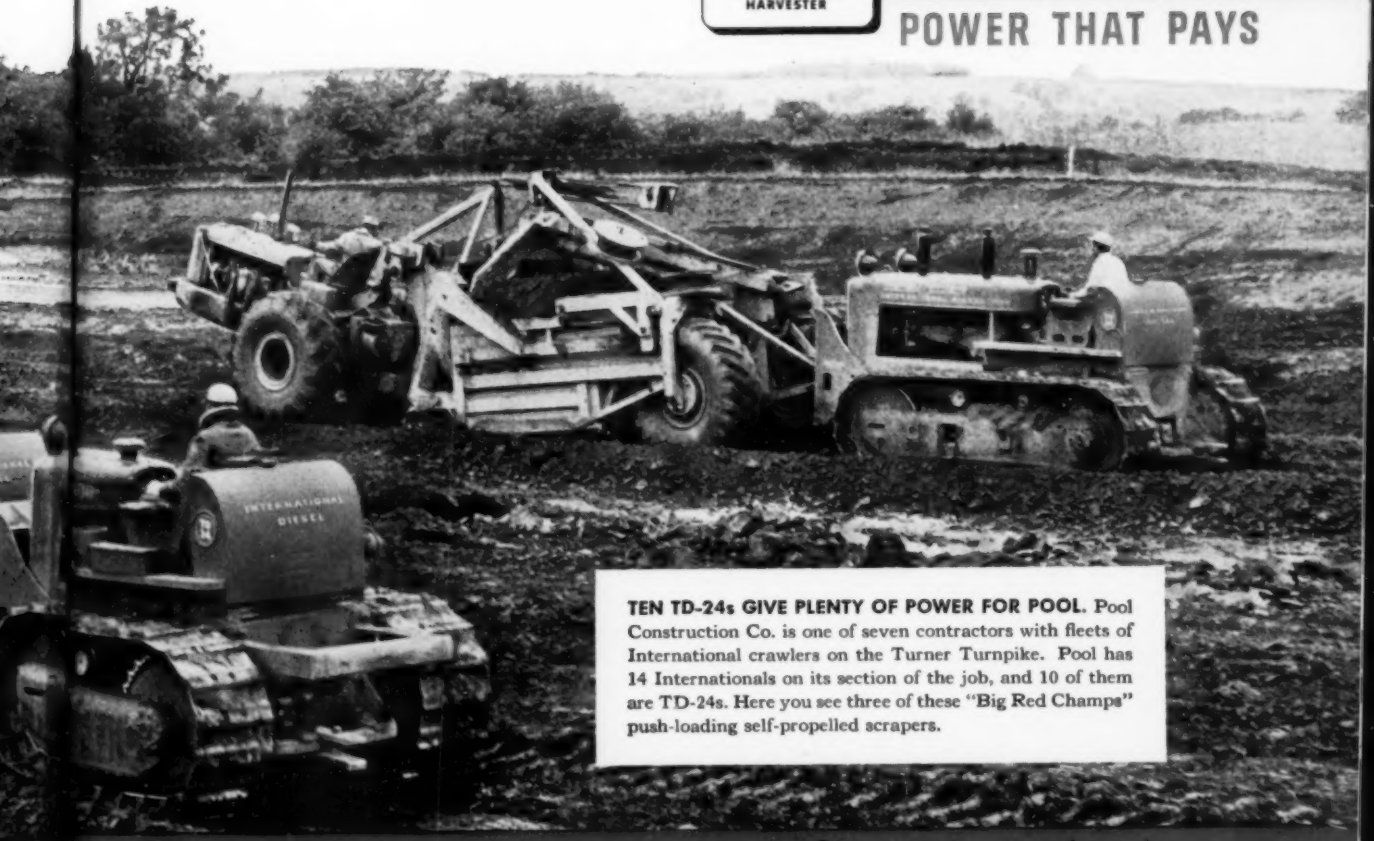
INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.

HAPPY CONTRACTOR is Vernon Pool (right) as he tells International Distributor D. V. MacDonald how good his TD-24s are. "One of them has 6,655 hours on the meter in three years," says Pool, "and it's working right along with the others."

INTERNATIONAL HARVESTER

INTERNATIONAL

POWER THAT PAYS



TEN TD-24s GIVE PLENTY OF POWER FOR POOL. Pool Construction Co. is one of seven contractors with fleets of International crawlers on the Turner Turnpike. Pool has 14 Internationals on its section of the job, and 10 of them are TD-24s. Here you see three of these "Big Red Champs" push-loading self-propelled scrapers.

HERE'S DESIGN ADVANTAGES
for pipe lines or plant piping

Whether you are designing a pipe line or plant piping you can simplify the job to save metal and money by specifying Armco Welded Steel Pipe.

Lengths up to 50 feet mean fewer joints to make, fewer sections to haul, handle and lay. Assembly is quickly done by field welding or standard couplers. And with Armco Pipe you can select exactly what is needed for the job. Diameters range from 6 to 36 inches and wall thicknesses from 9/64 to ½ inch. You buy no excess metal, make scarce tons of steel go further.

For plant or process piping you can take full advantage of the size range economies of Armco Pipe and also simplify piping layouts and assembly. Either standard or special fittings come welded to straight pipe lengths. At least one pair of flanges is eliminated at every bend to save time and money on installation and maintenance.

Why not design that next job for economy and efficiency with Armco Welded Steel Pipe. Write for complete data. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 2582 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

Export: The Armco International Corporation

Armco Welded Steel Pipe

ARMCO

widely used,
widely endorsed

ayr trap

THE AIR-ENTRAINING AGENT FOR CONCRETE

a large ready-mix plant: "Having used Ayr-Trap for the past four years with very satisfactory results places us in a position to recommend it to all ready-mix concerns."

a concrete block company: "We heartily recommend Ayr-Trap. The quality of the block is much improved and the appearance much better. The whole operation in making the blocks is easier."

a general contractor: "Horn Ayr-Trap is very beneficial to our construction due to the type of aggregate we use. The Ayr-Trap controls the set of the mortar by functioning as a dispersing agent."

a mining company: "We are firmly convinced that the use of Ayr-Trap makes a much more workable concrete, that stripped work has a much better appearance with a much greater resistance to damage from freezing."

Used in the newest State Turnpike circle and bridge construction

for heavy concrete construction

Ayr-Trap can be added at batching plants or on the job. It makes concrete more durable, increases its plasticity and minimizes segregation and bleeding. Increased plasticity with Ayr-Trap insures better placement of concrete in and around closely spaced reinforcing bars. Ayr-Trap develops high resistance to moisture absorption and attack from freezing and thawing forces.

road building

Ayr-Trap improves scaling resistance and protects pavements against the destructive action of chloride salts for ice, snow removal.

OTHER BENEFICIAL PROPERTIES

- Permits a reduction in the water cement ratio.
- Used in liquid form as follows:
  3 liquid ounces per cubic yard of 5 or 6 bag mix.
  1 pint for 5 cubic yards. 6 bag mix.

HORN

A. C. HORN COMPANY, Inc. est. 1897

Manufacturers of materials for building maintenance and construction
LONG ISLAND CITY 1, N. Y. • Los Angeles • San Francisco • Houston
Chicago • Toronto SUBSIDIARY OF SUN CHEMICAL CORP.

CE-2

A. C. HORN COMPANY, INC.,
Long Island City 1, N. Y.

Please send me ☐ complete data on AYR-TRAP

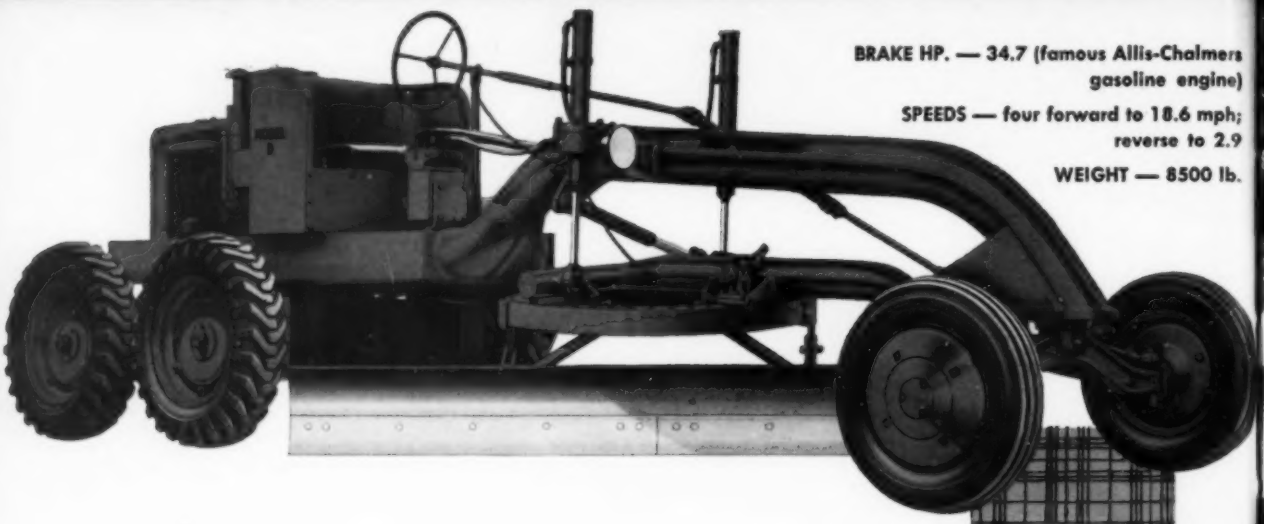
☐ free copy of your 96-page Construction Data Handbook

NAME_____ TITLE_____

FIRM NAME_____

ADDRESS_____

CITY_____ STATE_____



BRAKE HP. — 34.7 (famous Allis-Chalmers gasoline engine)

SPEEDS — four forward to 18.6 mph; reverse to 2.9

WEIGHT — 8500 lb.

only the Allis-Chalmers model D

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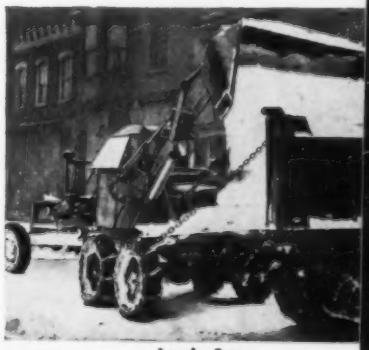

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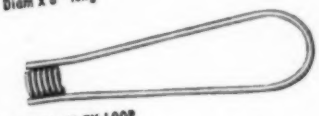
½" Diam x 4" long
¾" Diam x 6" long



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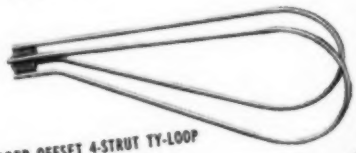

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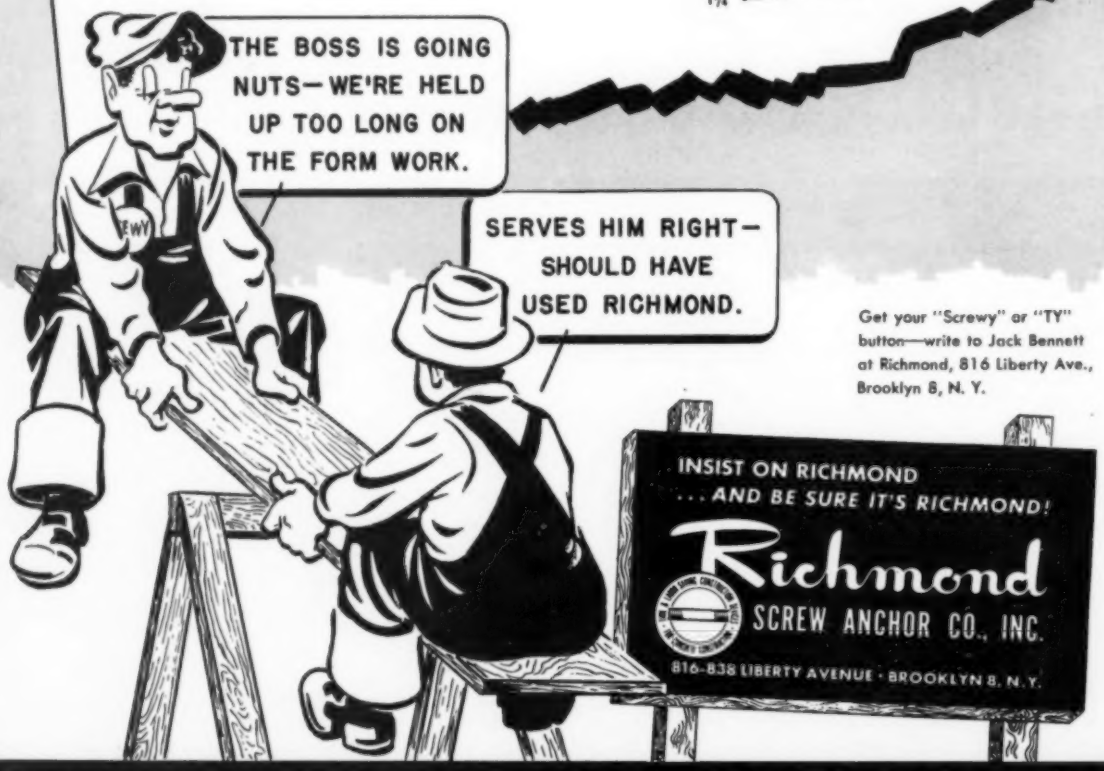
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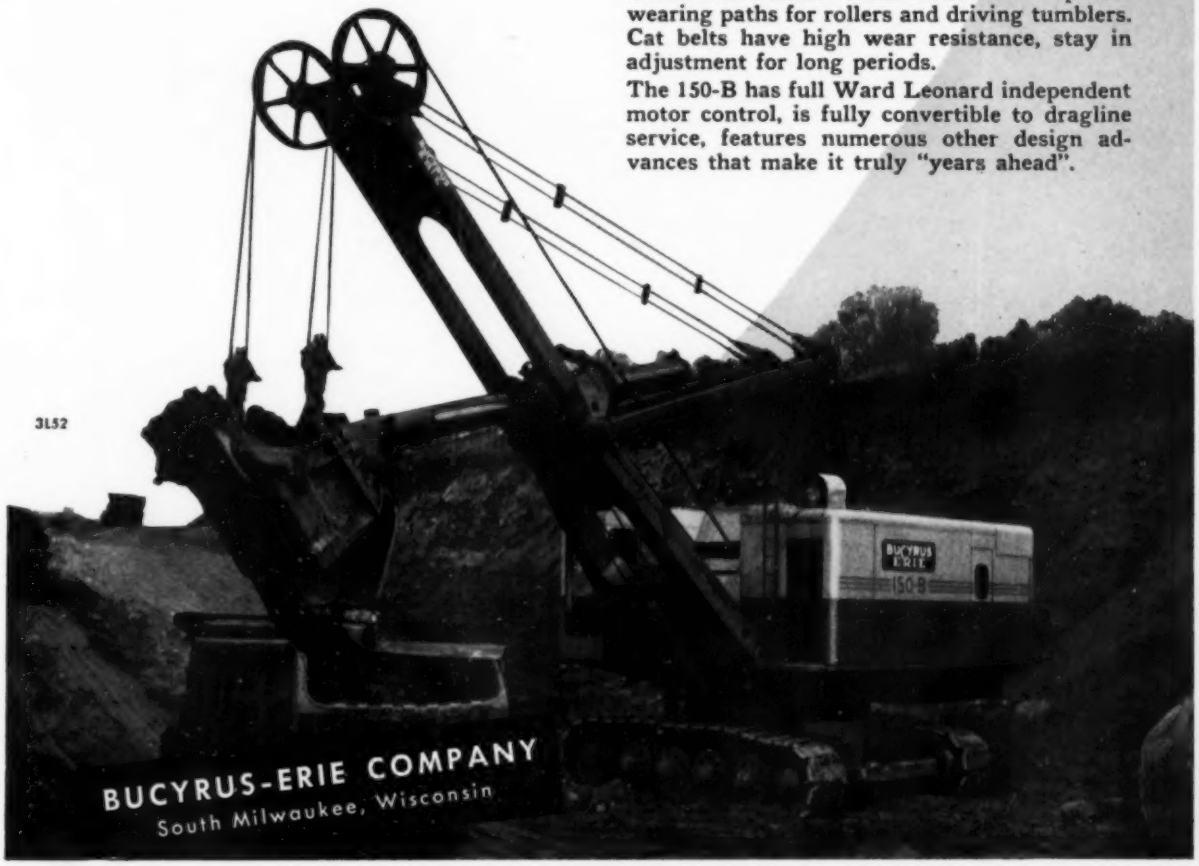

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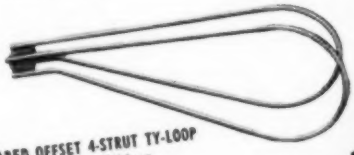

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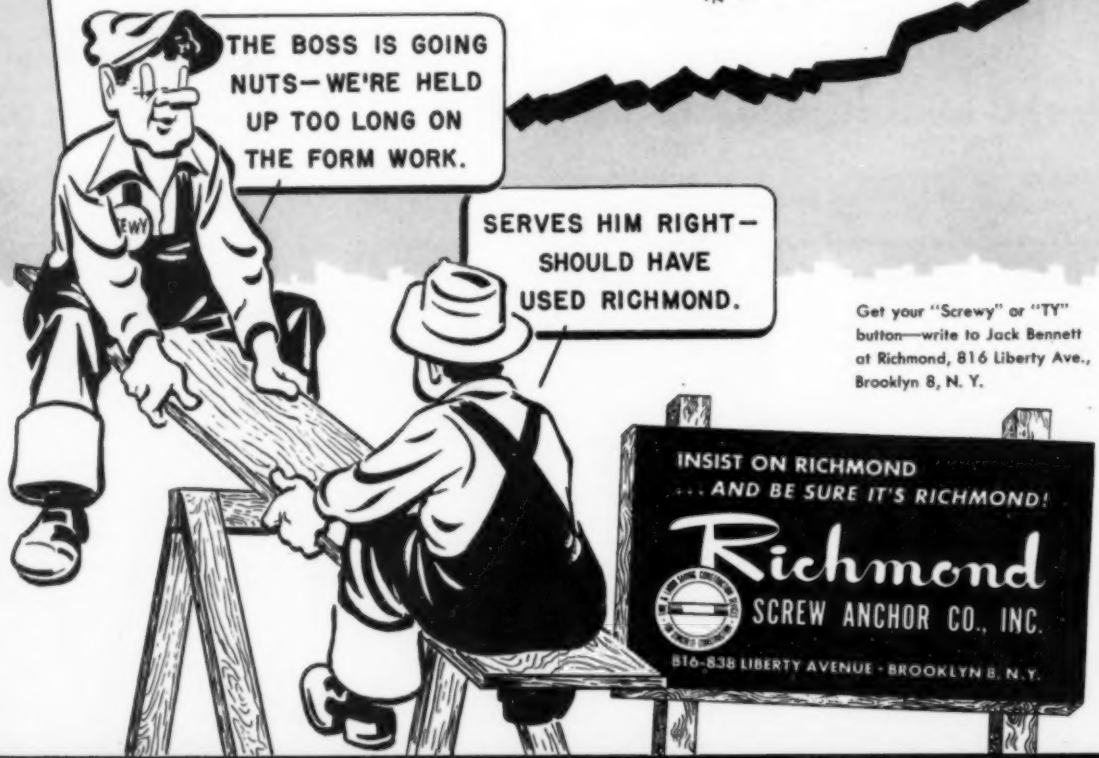
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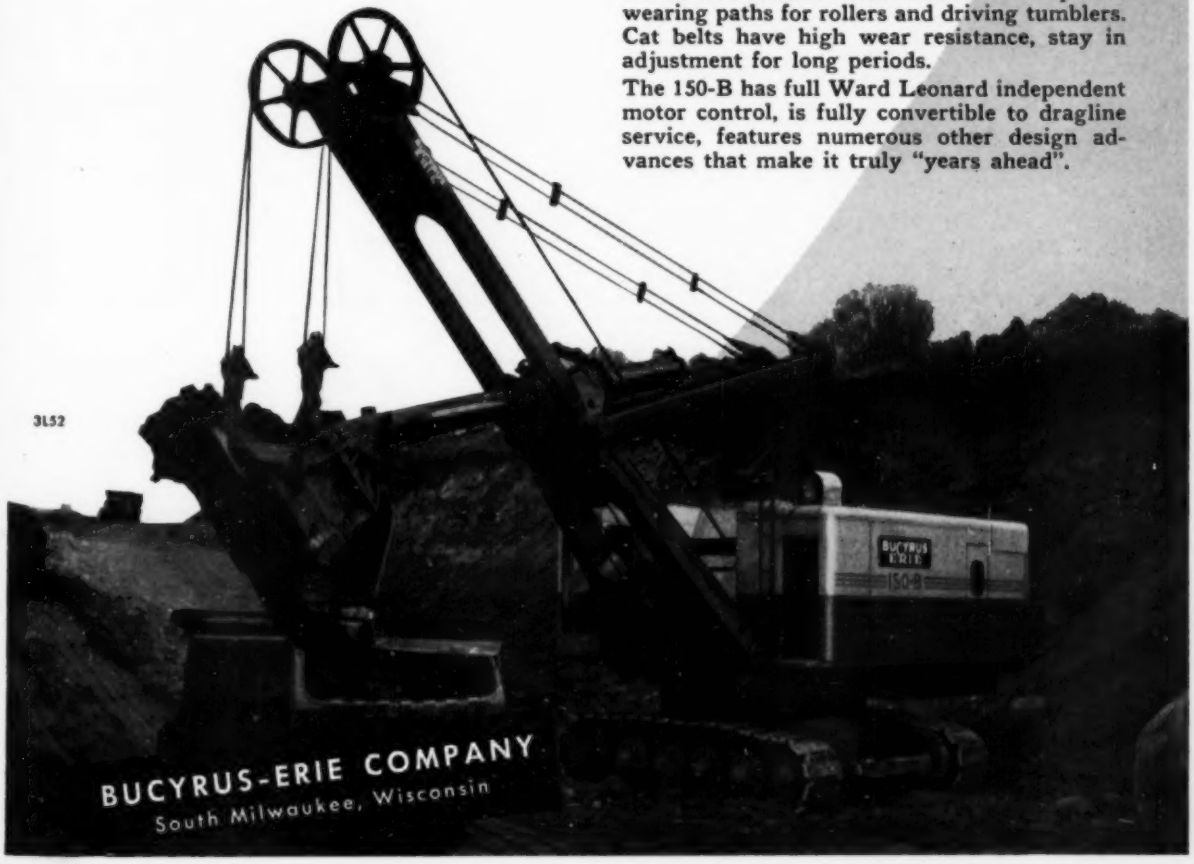

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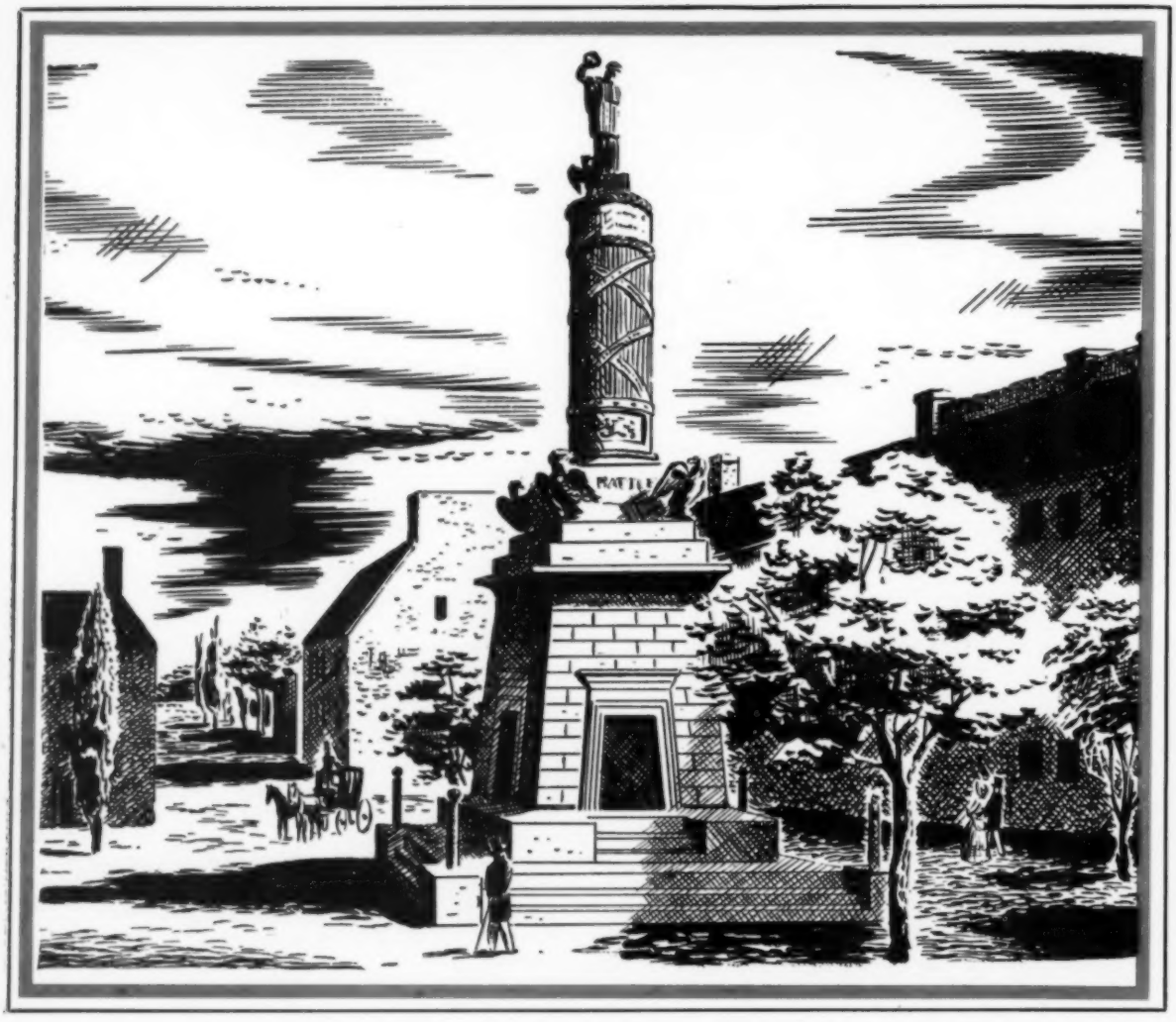

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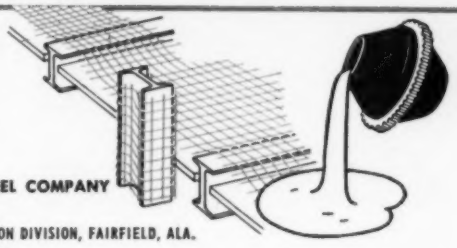

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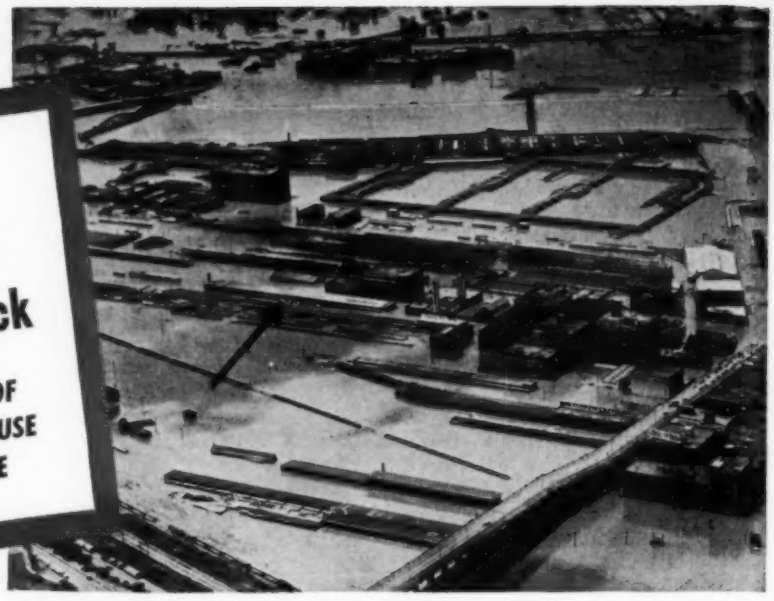

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● An idea of the driving energy behind the great comeback of Greater Kansas City, after last July's catastrophic flood, is conveyed by all-out speed in rebuilding the Santa Fe Freight House (arrow in photo, above) in the Central Industrial District.

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APRIL 1952

VOLUME 22

NUMBER 4

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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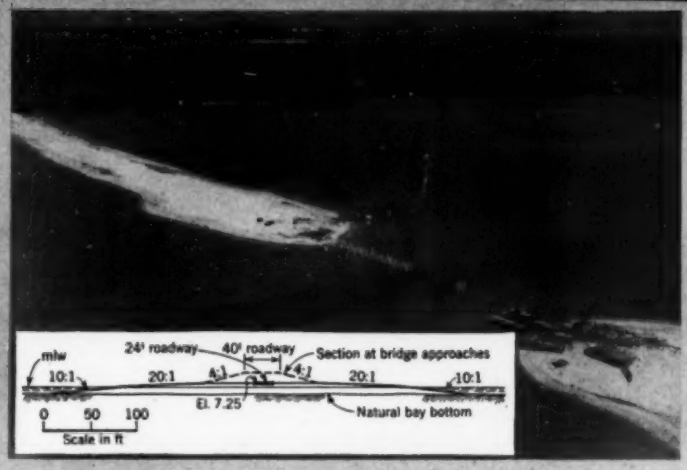


Lower Tampa Bay crossing stretches 15 miles to connect St. Petersburg with Palmetto, Fla. It includes a double-leaf bascule bridge with concrete approach trestles, two other steel bridges and two prestressed concrete trestle crossings. The five crossings, referred to in Fig. 1 at left as Structures A, B, C, D and E, are connected by ten miles of hydraulic fill. In picture above looking across Tampa Bay toward St. Petersburg, Fla., steam hammer rig is driving concrete piles for approach trestles of bascule bridge, Structure A, in gap in fill. Construction of this 15-million-dollar toll highway crossing, begun in 1950 by Florida Highway Department, is expected to be completed in 1954.

Photos by Bill & Bob.

MAURICE N. QUADE, M. ASCE

Partner, Parsons, Brinckerhoff, Hall & Macdonald, Engineers, New York, N. Y.

Fifteen-mile toll bridge under construction across lower Tampa Bay

It is not surprising that a crossing 15 miles in length, including nearly 11 miles of water crossing and a variety of structures, should present to its designers and construction supervisors a few problems of more than ordinary interest. The Lower Tampa Bay Bridge will form the last important link in the Gulf Coast Highway along Florida's west coast. It will connect Maximo Point in the city of St. Petersburg with U.S. Highway 541 at a point about one mile north of Palmetto.

Geographically the project is divided into an 11-mile crossing over Tampa Bay, a 2-mile crossing of Terra Ceia Island, a half-mile crossing of Terra Ceia Bay, and $1\frac{1}{2}$ miles of approach road on the mainland (see map on this page). Structurally the crossing is divided into 11 sections. Six sections are paved embankments varying from about 3,700 to 20,000 ft in length and having a total length of 54,024 ft—a little more than 10 miles. The six embankment sections alternate with the five structures, which vary in length from the 336-ft structure in Terra Ceia Bay to the 22,373-ft structure over the Tampa Bay ship channel.

The embankments, shown in Fig. 1, consist of hydraulic fill placed in the shallow waters of Tampa Bay, and in general were used for all parts

of the crossing where the normal water depth is 11 ft or less. The usual dry roadway embankment will be utilized on the natural land of Terra Ceia Island and the mainland. Pavement on the embankments will be 24 ft wide flanked by 8-ft stabilized shoulders and shrubbery for wind protection. Except at the bridge ends, the crown of the roadway is 7.25 ft above mean low water.

Beginning at the St. Petersburg (north) end, the structures are denoted as A through E. Structure A is 1,226 ft long. Its central span, shown in Fig. 2, is a double-leaf bascule that provides a 90-ft horizontal clearance over the Intercoastal Waterway. Symmetrically on both sides of the bascule are a steel flanking span and 14 concrete trestle spans each 36 ft long.

Structure B (Fig. 3) is 1,522 ft long. Its central span is a fixed steel-beam span 82 ft long which provides a vertical clearance of 17.5 ft at mean low water over a small-boat channel. The channel span is flanked on each side by 20 concrete trestle spans each 36 ft long.

The longest over-water crossing, Structure C (Fig. 4), is 22,373 ft long. It includes a group of steel spans placed symmetrically about the ship channel and having a total length of 5,621 ft. The remainder of the structure consists of 48-ft concrete trestle spans supported by precast concrete pile bents. On the north side there are 122 spans with a total length of 5,856 ft, and on the south side, 227 spans with a total length of 10,896 ft.

The steel span over the ship channel provides a navigation clearance of 800 ft horizontally and a minimum clearance of 141.5 ft vertically above mean low water. The 864-ft through-truss cantilever span is of conventional type. It is flanked by 360-ft through-truss anchor spans, on each side of which are two simple deck-truss spans 289 ft 3 in. long, and twelve deck-girder spans, six of which are 140 ft long, and six 100 ft long. Approach grades to the main span are 5 percent.

Structures D and E are identical. Each consists of seven 48-ft concrete trestle spans like those in Structure C. Structure D is in Tampa Bay near Terra Ceia Island, and Structure E is in Terra Ceia Bay.

On the steel spans in Structure C the bridge deck consists of a 28-ft roadway and two 2-ft-wide safety curbs or emergency sidewalks. On the through-truss spans the walks are raised above the roadway to form a 10-in.-high curb. Elsewhere on the steel spans a narrow curb separates the roadway from the 2-ft-wide walkway (Fig. 4). On the concrete trestle spans in all structures a raised curb 9 in. wide separates the 28-ft-wide roadway from the sidewalk, which has a clear width of 3 ft. The designers do not visualize pedestrians walking from St. Petersburg to Palmetto. The sidewalks are provided to accommodate the fishermen who festoon every bridge in Florida. Fishermen there have certain inalienable rights and they also pay tolls, which are welcome on any revenue-bond project such as this.

Construction Contracts Awarded

Funds were advanced by the Florida State Road Department for two initial contracts executed in October 1950, before the sale of the revenue bonds. Contract No. 1 covers construction of all the embankments north of Structure C—2,600,000 cu yd—but does not include the paving. Contract No. 2 covers the complete construction of Structures A and B.

The necessary legal and administrative steps delayed until September 1951 the sale of $21,250,000 of revenue bonds and the award of most of the remaining construction contracts. Contract No. 3 provides for the construction of the hydraulic embankments south of Structure C, about 1,240,000 cu yd. Contract No. 4, the largest of all, covers the construction of 17,424 ft of concrete trestle (363 spans) and 32 piers in the bay for the steel spans, at a cost of about $7,615,000. The steel superstructure requires about 6,050 tons of carbon and silicon steel, 3,800 cu yd of concrete in the deck, and 23,700 sq ft of steel bridge floor for the 864-ft cantilever span. This is covered by Contract No. 5.

Contracts have not yet been awarded for the pavement on the embankments and the construction of the toll houses and administration building. However these contracts amount to less than 12 percent of the total construction cost.

Design Standards Adopted

The standards adopted for design were those of the American Association of State Highway Officials except for wind loads and the unit stresses used in conjunction with them. The site of this crossing is exposed to hurricanes of severe intensity. Special consideration was given to wind loads and forces acting on both the superstructure and the substructure. Wind loads of 30, 50 and 75-psf intensity were investigated and used. See Table I.

For the substructure, basic unit stresses of f_c = 700 psi above water, f_c = 500 psi below water and f_s = 18,000 psi everywhere were adopted for dead plus live load design. These basic stresses were increased for conditions A and B.

For condition C the piers were checked for stability under a wind load of 75 psf and the unit stress in reinforcing steel was limited to a maximum of 30,000 psi. Longitudinal wind loads on piers supporting fixed ends of truss spans were assumed to be equal to 70 percent of the cumulative total of transverse wind loads acting on the structure alone. A factor of 60 percent was used for the girder spans.

Pile foundations for the steel spans were designed on the basis of 50 tons per pile for dead plus live load, and 65 tons per pile on any exterior row, or 70 tons per pile on any corner pile, under either condition A or B (Table I). Pile loads were not

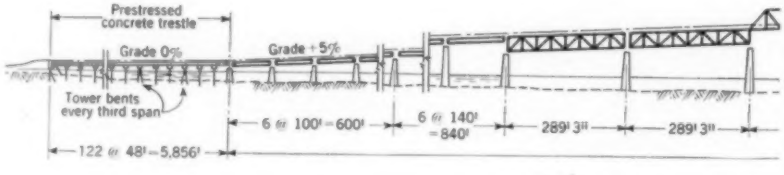


FIG. 4. High-level crossing over 800-ft ship channel (Structure C) provides 141.5-ft vertical clearance. Conventional through-truss cantilever is flanked by steel deck spans and prestressed concrete trestles. Structures D and E are identical, of same prestressed-concrete trestle design.

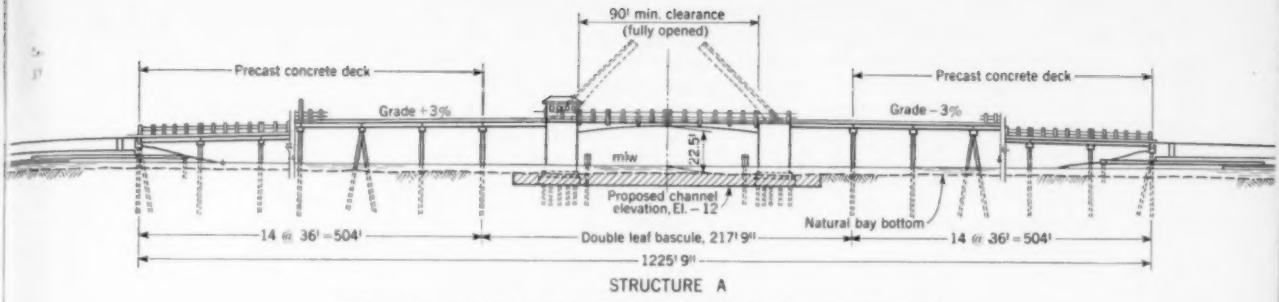


FIG. 2. Double-leaf bascule, flanked on each side by precast concrete trestles, forms Structure A, location of which is shown in map on page 25.

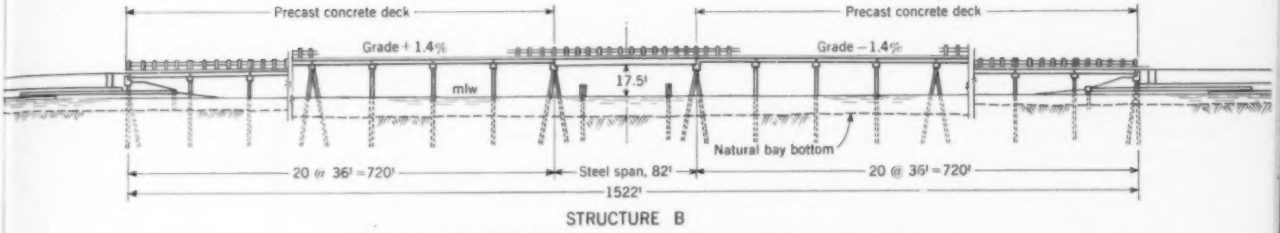
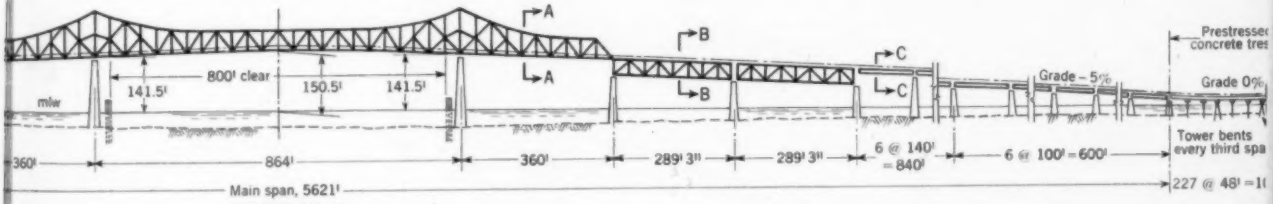


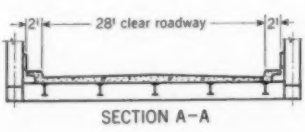
FIG. 3. Low-level bridge, consisting of precast concrete trestle and central steel-beam span over small-boat channel, forms Structure B.

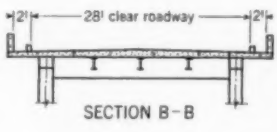
checked for a wind load of 75 psf since it is considered that such a wind pressure is necessarily a gust pressure and that the inertia of the structure will ordinarily prevent loads of that character from fully loading the piles. Moreover, the piles are believed to be capable of sustaining such infrequent overloads.

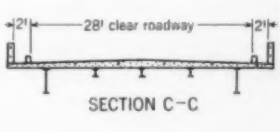
Although the structures have been designed to resist hurricanes of all known intensities, the hydraulically placed embankments are vulnerable to them. Quite probably a severe hurricane will damage parts of the embankments. At the bridge ends, protection for the embankments has been provided against erosion from tides and normal storms, and it may be effective in hurricanes. This protection will be extended to the more critical parts of the embankments if sufficient funds are available.

For this long crossing, to be used by many heavy semi-trailer trucks but not in sufficient quantity to cause undue congestion in any one span, H-15 loading was selected for the design of the steel trusses and girders, but the floor system of these spans was designed for H-20 loading. The effect of H-20 loading was also considered in connection with the design









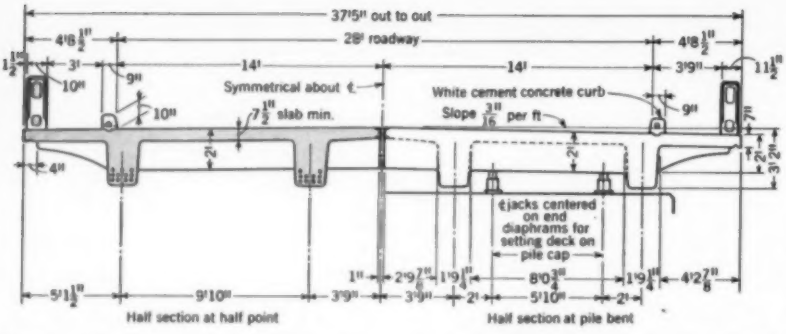

37'5" out to out
28' roadway
Symmetrical about ℄
White cement concrete curb
Slope 3/16" per ft
7 1/2" slab min.
℄jacks centered on end diaphrams for setting deck on pile cap
Half section at half point
Half section at pile bent

FIG. 5. Precast concrete trestle consists of precast deck divided along center line into two identical sections. Deck is erected on four-pile precast concrete bents spaced 36 ft on centers.

TABLE I.

Unit Stresses for Superstructure Design of Lower Tampa Bay Bridge

D = dead load, L = live load, I = impact, W = wind load, E = erection load (stress from all steel dead load in place + 50-ton traveler + 200 lb per lin ft of bridge for erection equipment).

	Loading	Condition	Unit Stress
For Members Designed Primarily for $D + L + I$:			
$D + L + I + W$	where W = 30 psf on structure + 200 lb per lin ft on live load	A	1.25 × basic*
$D + W$	where W = 50 psf on structure	B	1.40 × basic
$D + W$	where W = 75 psf on structure	C	See Note†
For Members Designed for W (or a small $D + W$):			
W or $D + W$	where W = 30 psf on structure + 200 lb per lin ft on live load	A	Basic
W or $D + W$	where W = 50 psf on structure	B	1.25 × basic
W or $D + W$	where W = 75 psf on structure	C	See Note†
For All Members:			
E			1.25 × basic
$E + W$	where W = 30 psf on structure, traveler, and equipment		1.30 × basic
$E + W$	where W = 50 psf on structure, traveler, and equipment		1.50 × basic
$E + W$	where W = 75 psf on structure, traveler, and equipment		See Note†

* Basic unit stress = $D + L + I$.

† Note: Stresses in any member shall not exceed the yield point. Stability of span as a whole is to be investigated for overturning, and anchorage to resist uplift is to be provided where needed.

of the concrete trestle spans and will be discussed later.

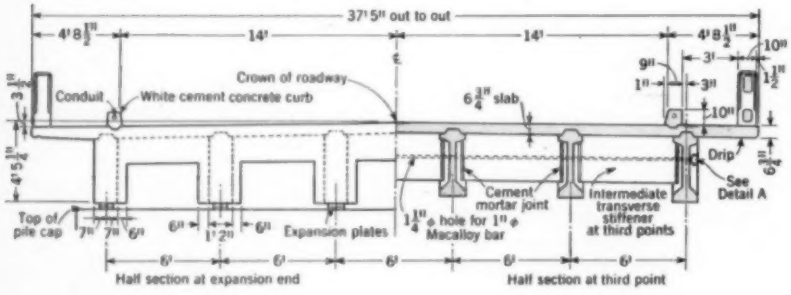
Complex Foundation Conditions

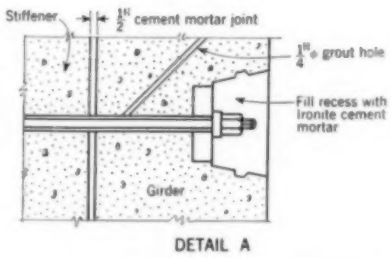
Exploratory work to determine foundation conditions consisted of 75 borings and 58 index piles (test piles for length). Complete records of resistance to driving casing for borings, dry sample spoons and index piles were obtained. From these data, types of foundations and estimates of contract quantities of materials were determined. The index pile records in particular enabled the contractors who bid on the job to prepare more realistic estimates of costs for driving the 210,000 lin ft of foundation piles of all types required for this project.

Geologically speaking, nature was rather uncooperative—in fact, almost contrary—in failing to provide even a partially consistent and logical pattern of soil strata beneath the bay. It is true that the same materials occur at most of the boring locations but they occur in almost every conceivable sequence and variation in thickness and hardness. The sand strata and their admixtures are sometimes loose (taking one blow or less per foot on the sample spoon) and sometimes partially cemented (taking 50 blows per foot on the spoon and 300 blows per foot on the casing). The limestone likewise varies from very soft to very hard—often in alternate layers—and varies in thickness from a few inches to 20 ft. This limestone is not bed rock. Perversely, some of the soil strata are upside down, that is, they become less firm with an increase in depth.

All the piers supporting the steel spans north of the main channel and the five piers carrying the truss spans on the south side, are supported on steel H-piles. The rest of the piers

FIG. 6. Prestressed concrete trestle consists of six 48-ft I-shaped stringers supported on concrete pile bents and carrying poured-in-place deck. Prestressing is in stringers and is provided by three 1-in.-dia British-made Macalloy bars threaded through stringers and post-tensioned to initial stress of 94,000 psi. This is first use of Lee-McCall system of prestressing in United States. Detail A shows section of typical stringer at center of its span.





are supported by spread footings resting on firm material as disclosed by the borings. All bases are to be constructed within cofferdams using an under-water concrete seal in accordance with usual methods for such construction.

Concrete Trestle

Alternate bids were taken on two designs for the 36-ft spans in the concrete trestle in Structures A and B. One was a poured-in-place design, the other a precast design in which each span is split along the center line of the bridge and is precast and erected in two identical parts, that is, identical when turned end for end. The bids received for Contract No. 2 did not indicate any substantial economy for either type over the other. Nevertheless the trestle in these two structures will be built as a precast structure (Fig. 5) at a saving in cost of about $10,000.

By the time bids were to be advertised on the trestle in Structures C, D, and E (to a total length of more than 3 miles), another design had entered the competition. This was a prestressed design prepared by the Preload Corporation of New York, which was carefully reviewed and approved by the engineers before it was accepted. It turned out to be the winning design among the three alternates by a margin of $184,000—subsequently reduced to $144,000 as will be explained later.

This design was not based on any one patented system of prestressed reinforcing. The Magnel system was shown as a standard of quality but other systems of equal quality and experience record were of course permitted by the specifications. The Magnel system uses cold-drawn high-strength wire, as do most other systems. The reinforcement to be used in the Tampa Bay Bridge will consist of high-strength bars produced in England and known as the Lee-McCall system.

The prestressed elements in the design are the 48-ft stringers spanning between the pile bents. Six stringers spaced 6 ft on centers carry the 37-ft 5-in. wide poured-in-place deck, which is cantilevered on each side beyond the outer stringers, as shown in Fig. 6. The diaphragms between the stringers for live-load distribution are placed at the third points. These diaphragms are precast and prestressed with a single rod after erection. All steel is post-tensioned after the stringers and diaphragms are precast.

Each stringer is an I-shaped beam 3 ft 4 in. deep, having a 4-in.-thick web and flanges 14 in. wide. The top flanges have $2^1/_2$-in. raised keys on the upper face to insure participation of the deck slab with the beam under live and impact loads. The stringers will be cast in metal forms at the contractor's yard at Port Tampa, using a special high-strength mix developing a minimum strength of 5,000 psi at 28 days. The concrete will be carefully vibrated and will contain Plastiment as an admixture.

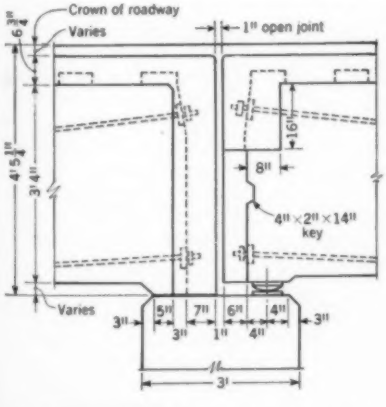
Following post-tensioning, the beams will be loaded on barges as needed and towed to the bridge site for erection in much the same manner as steel beams except for the fact that these beams must always be picked up at two points near the ends, and they must always be kept right side up. In a sense the contractor is establishing a manufacturing plant for the production of the 2,178 stringers required for the 363 trestle spans.

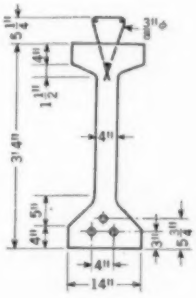
The prestressed reinforcement in each stringer consists of three 1-in.-dia Macalloy bars. The two outside bars are straight, but the middle bar is gradually curved upward at the ends to eliminate direct tension in the upper flange at the ends. Frankly, we know very little about the chemical properties of these bars or the process by which they are made. They appear to be made of a high-carbon steel stretched in some manner during manufacture.

We do know, however, about the essential physical characteristics of the steel, as these have been generally confirmed by tests in the United States. A typical stress-strain-curve appears in Fig. 7. This is a high-strength steel having a guaranteed minimum ultimate strength of 145,000 psi and a corresponding minimum elongation in 8 in. of 8 percent. It is practically creepless—an important characteristic of reinforcement for prestressed concrete—and has a minimum strength of 70,000 psi for a 0.01-percent set proof stress, and a minimum strength of 130,000 psi for 0.2-percent set. The modulus of elasticity is calculated to be about 25,000,000 psi.

One of the features of the Macalloy bar is the patented high-efficiency nut used at each end of it. When properly fitted, this nut can develop a strength equal to about 96 percent of the strength of the body of the bar without resorting to upset threads. This efficiency is achieved by the use of: (1) fine threads throughout most of the length of the thread, and (2) a finer taper thread about five threads in length at the inner end. The nut is, of course, longer than that for a standard cylindrical thread. If the nut, when tightened on the bar thread, is not correctly positioned with respect to the last bar thread, the efficiency of the nut may be reduced to as little as 80 percent. One of the criteria for the inspection and acceptance of the bars and nuts at their place of manufacture will be the tightened position of the nut.

Prestressing is accomplished by a special hydraulic jack connected by a threaded coupling to one end of the bar, which is provided with a 3-in. extension of the cylindrical thread for that purpose. The prestressing force is measured primarily by the elongation of the bar (about $2^1/_2$ in. for these beams) rather than by jack pressure which does, however, furnish a check. Simple prestressing procedures automatically adjust, by means of shims, variations in the in-to-in dimensions of the nuts when tightened in correct position at the ends of the bar threads, and also adjust the out-to-out dimensions of the bear-





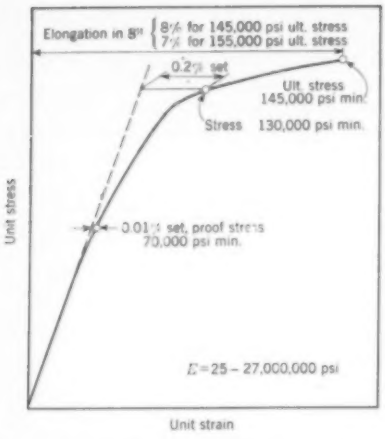


FIG. 7. Stress-strain relationship for Macalloy bars used in British Lee-McCall system of prestressing is shown by curve.

ing plates cast in place at the ends of the stringers.

The contractor's design submitted with his bid proposed to coat the bars with a suitable bituminous compound to permanently destroy bond (but at the same time protect the bars against corrosion), thereby permitting him to place them in correct position in the forms before pouring the concrete. This scheme would have saved the cost of forming holes through the beams for the bars, removing the wire-cored solid rubber hose used for forming the holes, threading the bars through the holes, and grouting the bars in place after tensioning—altogether a considerable amount of work. But of course under this scheme, the end nuts serve as permanent anchorages for all bars and are subject to repeated stresses from live load—unlike the situation when the bars are bonded by grouting under pressure after tensioning.

Fortunately (or unfortunately, depending on the point of view), this design was submitted for review and approval to three University of Illinois graduates who, because of the important studies of fatigue of metals made at Illinois, are "fatigue conscious." Threads in high carbon steel might mean low fatigue strength. The question was, how low would this fatigue strength be and what would constitute proper criteria?

Reaching into thin air, it was decided to use a stress range of 23,000 psi, with a lower limit of 79,000 psi and an upper limit of 102,000 psi, and to establish a minimum fatigue resistance of 3,000,000 cycles. The lower limit was determined by deducting from the initial prestress of 94,000 psi, the full amount of the anticipated losses. The upper limit was determined by deducting half the losses and then adding live load and impact and an arbitrary increment of 10,000 psi. If the bars met that requirement, the Illini were satisfied.

Accordingly, two fatigue tests were made on a bar and nut assembly at Illinois under the direction of Prof. Nathan M. Newmark, M. ASCE. The first specimen failed at 26,000 cycles, the second at 20,000 cycles! Keeping the same upper limit of 102,000 psi, a third specimen was tested with a range of 10,000 psi and a fourth with a range of 5,000 psi. The third specimen failed far short of its goal at 240,000 cycles. The fourth passed its goal and was still going when the test was stopped at 3,150,000 cycles. But the 5,000 psi was uncomfortably close to the actual live load plus impact stress in the 1-in. bars (about 4,000 psi for H-20 loading). Obviously, fatigue strength would be extremely critical for a railway bridge or any other structure having proportionately larger live load and impact stresses.

In the belief that larger bars, and therefore lower unit stresses, might increase the fatigue resistance, further tests were conducted on $1^1/_8$-in. dia bars using an upper limit of 80,000 psi. The first specimen failed under a range of 10,000 psi at 313,000 cycles, showing very little more fatigue strength than the bar tested at the same range but with an upper limit of 102,000 psi. Again holding the upper limit but reducing the range to 7,500 psi, the next specimen so tested failed at 1,461,000 cycles. Another specimen tested with a range of 5,000 psi passed 3,000,000 cycles before the test was stopped.

These tests indicated to us that pressure grouting the bars after tensioning was essential to establish bond and so relieve the nuts of the live load and impact stress that might cause fatigue failure. The contractor estimated that the net additional cost to him for the necessary work involved would be $40,000. This appeared reasonable and the contract sum has been increased by that amount.

Lack of extensive competitive bidding indicates that the $144,000 net saving in cost may not be a true measure of the relative economy of the designs. Certainly much more will be known about that by the time the job is completed. Because of relatively high labor costs in the United States, costs of prestressing high-strength creepless bars or their equivalent may prove to be less than that of prestressing a larger number of individual wires.

It is assumed that it would be possible to manufacture in the United States high-strength creepless round bars of the diameters and lengths required for such work. If the grouting of bars in holes having small clearances around the bars is shown by tests to be entirely effective for bond, a patent-free standard A.N.F. thread developing approximately 80 percent of the strength of the body of the bar might provide sufficient anchorage for initial prestressing. Perhaps the use of an upset thread is not beyond the realm of possibility for such high-strength steel. Neither can we exclude the possibility of the development of a steel which will show sufficient fatigue strength to permit the use of coated bars, and of course the elimination of grouting and incidental work. In that connection, however, it should be emphasized that the margins of strength (ultimate vs. design loads), and the behavior at failure under ultimate load, of two beams identical in design and construction except for bonding of the prestressed reinforcement, are quite different. It is not a question of simple substitution of unbonded bars for bonded bars. The design must be based on one or the other condition.

One characteristic of the prestressed design for this project not previously mentioned is the fact that there is a small residual compression in the bottom flanges of the beams under H-20 loading. As designed, the concrete will not crack until and unless the live load exceeds H-20. Cracks resulting from overload will close up on removal of the load. For a low structure over salt water in a warm climate this is a very important advantage from the standpoint of durability and cost of future maintenance.

Perhaps we are on the threshold of a large expansion in the use of prestressed concrete. Certainly much knowledge can be gained from its use on a project of this magnitude. Its principal advantages will be found in its development along the general lines indicated here and in its use on those projects where a considerable number of repetitive identical units are required, although not necessarily any such quantity as the 2,178 stringers required for the Tampa Bay Bridge.

(This article was prepared from the paper presented by Mr. Quade before a Structural Division session presided over by George E. Brandow, at the ASCE New Orleans Convention.)

Proposed Mississippi River parkway to utilize existing highways

J. LESTER WHITE, M. ASCE, Director, Louisiana Department of Public Works, Baton Rouge, La.

An innovation in parkway construction is proposed in a federal survey for a projected 2,000-mile highway along the Mississippi River from its source to the Gulf of Mexico. Authorized by Congress in 1949, the survey proposes utilization of at least 60 percent of existing facilities to make the project economically feasible. Otherwise, the cost of such a parkway, which will extend from the north woods of Minnesota to the passes more than 100 miles below New Orleans, would be prohibitive. According to the survey, however, a continuous parkway could be constructed at minimum cost by converting existing Mississippi Valley roads to parkway standards and connecting them with newly constructed highways. Agencies conducting the survey were the Bureau of Public Roads and the National Park Service.

The ten river states affected and the federal government would be required to share responsibility for the project. However, the parkway, with its parks, historical sites, and recreational areas, would be built, owned, and operated by the states. While it would not actually be a superhighway, it would function in part and incidentally as such. Widths of pavement would be gauged to the requirements of traffic as it grows. Full and partial control of access and separation of truck traffic were considered as desirable objectives, not immediately attainable but susceptible to immediate planning and gradual accomplishment. As an important means of conservation and to prevent the location of industry immediately along the road itself, it is planned to purchase scenic reservations outright. Lands of submarginal character, often best for sports and other park purposes, would also be acquired. Wherever an easement will suffice, the plan contemplates that only this type of right will be obtained. These parts of the project would be financed out of regular federal-aid highway funds with additional participation of the government to carry out the parkway phases of the program. In the main, the program is to buy, or otherwise control, a long corridor of land through the Mississippi Valley. This reservation will permit widening highways as required as well as saving some of those scenes of rural beauty and history that once lost are gone forever.

Obviously old methods of reconnaissance by "flagging" routes in the field were too time-consuming for such great distances. Therefore, aerial photographs covering the survey area were obtained, and modern photogrammetric methods were used to select the most feasible routes from the standpoint of topography and land use. Even though most of the staff had to be trained in the new techniques, the work progressed much faster than if the time-honored ground reconnaissance methods had been employed. From time to time, however, the results obtained by use of the stereoscope and the aerial photographs were checked by reconnaissance in the field with the photographs in hand.

The planners of the project are convinced that a Mississippi River parkway—initiated on a realistic basis and designed to grow with the country—would be not only practical but highly desirable. This conclusion is based primarily upon the recreational values and the tourist appeal of such a road and upon the resulting conservation of scenic, historic, and wildlife resources. Although not primarily intended as a freeway to hurry traffic from city to city and from region to region up and down the Mississippi Valley, the project would serve this purpose in an area where present traffic loads may be expected to grow. The military advantages during an emergency, of a high-standard, direct route stretching from near the Canadian border to the Gulf through the industrial heart of the nation are too obvious to require elaboration.

Furthermore, the parkway as presently envisioned by the survey staff would not be an all-out federally constructed and operated project of the type known on the Blue Ridge and the Natchez Trace. It would be designed, built, owned, and operated by the river states, with only such cooperation and direction at the federal level as would be necessary to assure continuity of the route and uniformity of design. Financing would be within the structure of the Federal-Aid Highway Act, with additional federal participation to transform the highway thus built into a parkway.

All of the road, both old and new, would occupy only the right-of-way standard to federal-aid highways. The preservation of the roadside scene would be accomplished by establishing simplified scenic easements over the lands adjacent to the right-of-way. These reservations would consist, in essence, of the purchase of certain development rights, and they would extend only as far as necessary to prevent the despoilation of that section of the valley landscape within view of the parkway traveler. In addition, certain outstanding wild areas and scenic and historic sites would be purchased outright and added to the parkway system.

A whole new era of development of common interests can best be realized by placing in proper perspective one thing which both the Upper and Lower Mississippi Valleys undoubtedly have in common—the Mississippi itself. A new approach to parkway planning, the proposal is also potentially important to the nation as a whole. Progress knows no geographical limitations within the United States, and progress anywhere must ultimately lead to progress everywhere. The Mississippi River parkway plan is a chart for further progress in our country.

(The preceding article is abstracted from a paper presented by Mr. White before the City Planning Division, presided over by Harry W. Alexander, at the New Orleans' Convention 1952.)

More U.S. power available at Niagara

From the first use of the Niagara River power almost two hundred years ago until today, plans for further development of the power possibilities of the river have been made. Use of the latent power of the Falls for generation of electricity began in 1881 with construction of the first commercial hydroelectric generating station. From then until completion of the Queenston-Chippawa plant in Ontario in 1930 there has been a continuous increase in the development and use of Niagara power.

Until the turn of the century there was little concern over the possibility that increasing diversions for power would harm the scenic spectacle of the Falls and Rapids. Studies of this possibility made by various groups after 1900 led to the passing of the Burton Act in 1906 and the Boundary Waters Treaty in 1909. The treaty limited power diversions to 20,000 cfs in New York and 36,000 cfs in Ontario.

Niagara River and Falls Described

The 36-mile-long Niagara River, the natural outlet for the 263,500-sq mile watershed of the four western Great Lakes, drops 326 ft between Lakes Erie and Ontario. A map of the river is given in Fig. 1 and its profile, Fig. 2, shows the considerable available drop in the Rapids above and below the Falls. Its flow is extremely steady and dependable because of the extensive storage in the Great Lakes system. Based on flow records available since 1860, an average annual flow of 197,000 cfs can be expected, with probable maximum and minimum monthly averages of 256,000 cfs and 130,000 cfs, respectively. If records since 1905 only are used, the average annual flow would be 193,600 cfs. Flow-duration curves are shown in Fig. 3.

The major drops in the river are 50 ft in the Cascades or Upper Rapids extending one mile above the Falls, 167 ft at the Falls, and 97 ft in the turbulent Lower Rapids extending six miles below the Falls in the famous Gorge with its nearly vertical cliffs over 300 ft high. This gives a gross head of 314 ft available for power development in a seven-mile stretch of the river.

Goat Island at the Falls divides the river into two channels, leading to the American Falls and the Canadian or Horseshoe Falls with crest lines of 960 and 2,875 ft, respectively. Recession of the American Falls and the part of the Horseshoe Falls that lies in New York has been relatively small in the past two centuries. Since 1764, the earliest record of the shape of the Horseshoe Falls, the recession of the crest in the center of the Horseshoe has been nearly 900 ft with the result that flow over these Falls is being more and more concentrated in the center of the Horseshoe, with 90 percent of the flow passing over the center half of the crest, leaving the flanks dry on either side. As an additional result, less water has flowed over the American Falls, exposing ledges to mar the scenic spectacle, especially at lower flows. Contrary to general opinion, entirely stopping power diversions from the river would tend to accelerate the recession of the Falls.

Redevelopment Studied

Major studies for redevelopment of the Niagara to preserve the scenic spectacle include those of the Army Engineers in 1920 (the Warren Report), of the Special International Niagara Board in 1929, of the Power Authority of the State of New York in 1938, and of the Federal Power Commission in 1949. Modifications of the 1949 plan are being studied by the Power Authority, the Niagara Mohawk Power Corp. and the Buffalo District Office of the Army Engineers. The importance of preserving the beauty of the Falls, which were visited by an estimated 4,000,000 people in 1950, has been stressed in all the studies.

Proposals by the Army Engineers, the Niagara Board, and the Niagara Mohawk Power Corp. before 1949 all recommended a step-by-step development and continued the priorities contained in the 1909 Treaty—namely, (1) navigation, domestic and sanitary uses, (2) power, and (3) scenic spectacle. In other words, after navigation, domestic and sanitary uses were satisfied, a fixed diversion would be granted for power purposes with the scenic spectacle taking the remaining variable quantity of water.

The Power Authority of New York, in a three year study of a coordinated Niagara-St. Lawrence project published in 1938, recommended two major changes in the proposed Niagara redevelopment. First, instead of a step-by-step development, it recommended that a determination be made of all water available for power and that this water be developed in an overall 314-ft development. Second, it recommended that the scenic requirements for water be fixed to agree with the Niagara Board's conclusions, with power given the lowest priority and receiving the variable amounts of water remaining after providing for the scenic spectacle. This water would be divided equally between New York and Ontario. The Power Authority also recommended that night flows not needed for scenery be stored in Lake Erie by use of control works at Buffalo and used during daytime peak-power periods.

The 1949 report of the Federal Power Commission, prepared with the technical advice and assistance of the Power Authority and the Power Corporation, adopted the Authority's recommendations for planning an ultimate rather than a step-by-step development, for providing a fixed flow for scenery and a variable flow for power, and for constructing control works at Buffalo to store excess flows. Control works, in addition to providing regulation of outflows, would alleviate the ice problem in the river by keeping the ice in Lake Erie. The report also adopted the recommendation of the Power Corporation that a pumped storage development be constructed for daily storage of night flows.

1950 Niagara Treaty Signed

A new treaty with Canada, based on the 1949 report of the Federal Power Commission and covering the use of Niagara River waters for scenic and power purposes, was negotiated. The treaty was signed on February 27, 1950, and officially proclaimed on October 10, 1950.

The treaty specified that during daylight hours of the tourist season (8 a.m to 10 p.m., April 1 to September 15, and 8 a.m. to 8 p.m., September 16 to October 31) the flow of water

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Under terms of a treaty between the United States and Canada, which was signed in October 1950, flow over Niagara Falls during daylight hours of the tourist season must be at least 100,000 cfs to provide an adequate scenic spectacle, with a minimum at other times of 50,000 cfs. Flows larger than these figures are now available for power—one-half in Canada and one-half in the United States. An average of 65,000 cfs is the share for each country—a considerable increase over the 20,000 cfs previously available in the United States. Existing and proposed plants for utilization of all water available for power and the full 314 ft of drop in Niagara Fall and the Rapids above and below them are shown in Fig. 1 (right). A profile of Niagara River between Lake Erie and Lake Ontario, a distance of 36 miles, appears in Fig. 2 (right). In this article the authors discuss several proposed plans, estimated to cost about 300 million dollars and to take from four to six years to build, and three pending legislative proposals for financing and constructing the proposed Niagara redevelopment—federal, state and private. Drawing below by A. Leydenfrost for Power Authority of the State of New York.

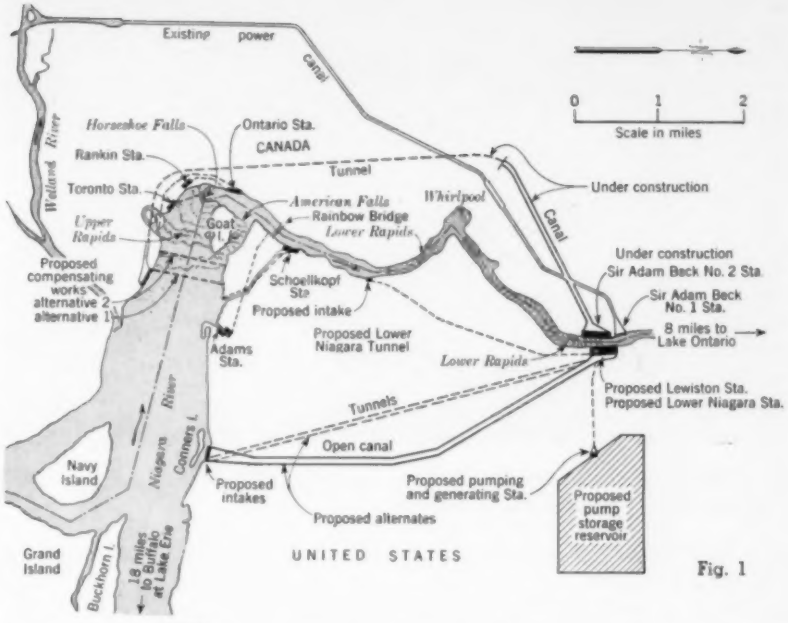


Fig. 1

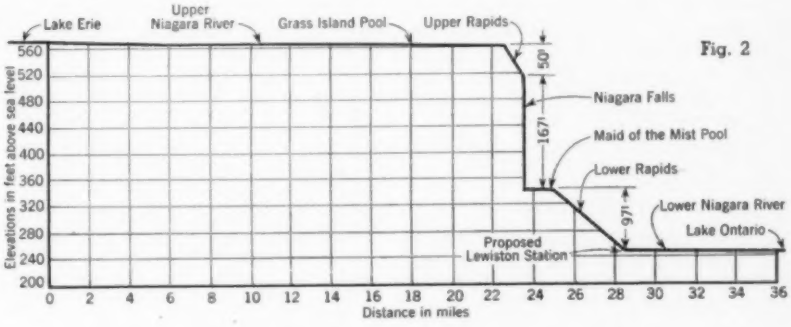
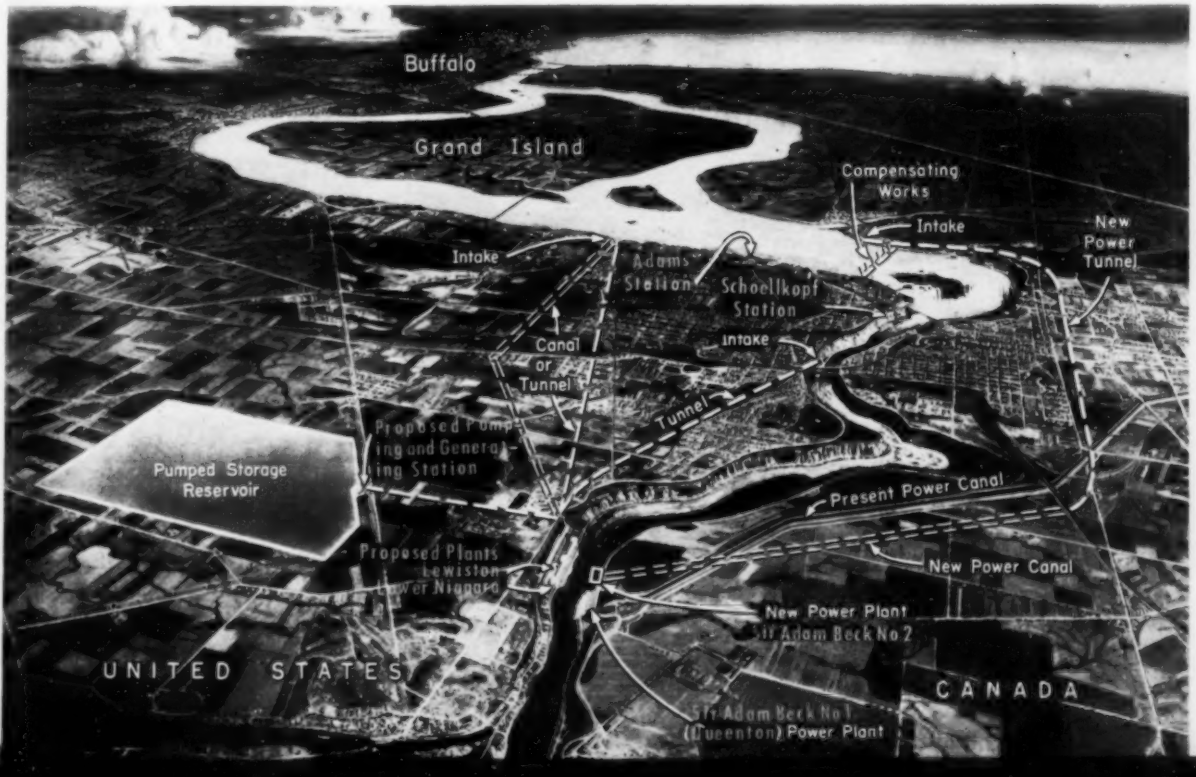


Fig. 2



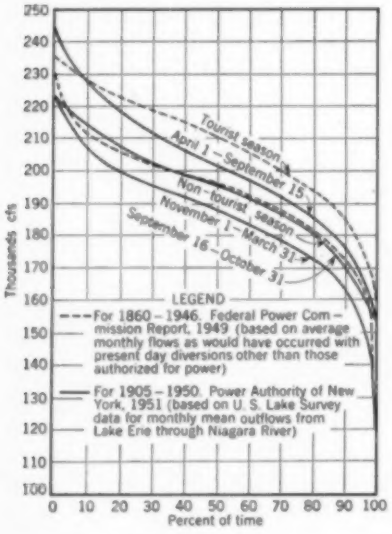
Aerial photograph of Niagara Falls from Canadian side shows, left to right, Rainbow Bridge, American Falls, Goat Island and Horseshoe Falls.

over the Falls would be at least 100,000 cfs and at all other times would be at least 50,000 cfs. Minimum flows of 50,000 cfs would be increased when additional water was needed for flushing ice above the Falls or through the Rapids. All remaining water could be diverted for power purposes and divided equally between power plants in New York and Ontario.

Compensating Works Studied

To meet emergency needs for power the United States and Canada had agreed in the period 1941–1944 to allow additional diversions for power, the new totals being 32,500 cfs in New York and 54,000 cfs in Ontario. Total hydroelectric installations in the area today are 445,000 kw in New York and 848,000 kw in Ontario. Provision was also made for construction of a part of the compensating works recommended in 1929. During the 1942–1944 period a submerged weir was constructed at the head of the Cascades above the Falls, raising the level of Grass Island pool about 1 ft at standard low water and increasing the power output of all plants with intakes above the weir. The weir also improved the appearance of the American Falls by increasing flows over them from 4.7 to 9 percent. Works for redistribution of water to secure an unbroken crest line and to cover the flanks of the Horseshoe Falls are provided for in the 1950 Treaty and are under study by the International Joint Commission on hydraulic models at Vicksburg, Miss., and at Toronto, Ontario. See Fig. 1 for location of the compensating works proposed in 1929, marked "alternative 1."

FIG. 3. Flow Duration Curves of Niagara River at Buffalo.


Thousands cfs
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
0 10 20 30 40 50 60 70 80 90 100
Percent of time
Tourist season April 1 – September 15
Non-tourist season November 1 – March 31
September 16 – October 31
LEGEND
For 1860 – 1946. Federal Power Commission Report, 1949 (based on average monthly flows as would have occurred with present day diversions other than those authorized for power)
For 1905 – 1950. Power Authority of New York, 1951 (based on U. S. Lake Survey data for monthly mean outflows from Lake Erie through Niagara River)

Studies made by the Power Authority in July 1949 disclosed that, with flows of 50,000 cfs over the Falls and no additional compensating works, the level of Grass Island pool would drop over 3 ft with a consequent loss of power, greater concentration of flow over the Horseshoe Falls, and a relatively small flow over the American Falls. The remedy then suggested was to raise the existing submerged weir from El. 554.50 to 560 and extend the weir to spillway structures on either shore. The pool level could be raised from El. 563 to 565, which would provide a permanent outflow of 50,000 cfs over the Falls. Additional outflows required to raise this to the 100,000 cfs required during the tourist season would be passed through gated spillway sections at either end of the weir.

This recommendation was made on the assumption that control works for water and ice would be constructed at Buffalo. With the treaty ruling out control works at the present time, the structure may require modification to permit adequate handling of the ice. The International Joint Commission, whose report is planned for April 1952, is now studying compensating works to accomplish this purpose. Model tests made to date indicate that without compensating works it would take several hours daily to change flows over the Falls from 50,000 to 100,000 cfs and vice versa with a substantial loss of water for power during these changeover periods.

Alternate compensating works were studied by the Power Authority in 1951, as follows:

Alternative No. 1. It is proposed to build a new submerged concrete weir, 3,230 ft long, about 2,000 ft above Goat Island in front of the existing submerged weir at the location shown on Fig. 1, marked "alternative 1." The horizontal crest is at El. 561.60 and, with a pool elevation at 564.00, would provide a constant quantity of 50,000 cfs. Gated spillway sections with five 100-ft openings on the Canadian shore and five 80-ft openings on the American shore are proposed. The crest at the upper part of these gates would be at El. 561.60. With all gates open and the pool at El. 564, a total discharge of 200,000 cfs could be obtained.

Alternative No. 2. A concrete dam 3,684 ft long would be located about 600 ft above Goat Island with the crest at El. 562, excepting a center notch 484 ft long with crest at El. 555. On the Canadian shore two spillway openings with taintor gates 100 by 20 feet and ten siphon spillways with 4 by 12-ft pipes are proposed. At pool El. 564, the siphons have a total capacity of 8,200 cfs.

For flows of 50,000 cfs over the Falls, the pool is assumed at El. 563, rising to El. 564.40 for discharges of 100,000 cfs over the Falls. This change in elevation will require about one and one-half hours for total outflows of 180,000 cfs and about one-half hour for total outflows of 220,000 cfs. Total discharge capacity of these works at pool El. 564.40 would be 150,000 cfs.

Alternative No. 3. If the pool elevation has to remain at El. 563, the structure in alternative No. 2 could be modified by adding two additional gated spillways 100 ft wide on the Canadian shore and four siphon spillways on the American shore with capacity of 3,050 cfs. Total discharge of this alternative could be up to 146,000 cfs.

These alternative structures would have the following advantages over

existing conditions: (1) amounts of water required for the scenic spectacle of the Falls and for use in Canadian plants could be accurately provided; (2) a permanent level for Grass Island pool could be maintained; and (3) in an emergency the storage capacity of the river above the works could be utilized.

Federal Power Commission Plan—1949

The Bureau of Power of the Federal Power Commission issued its report, "Possibilities for Redevelopment of Niagara Falls for Power," in September 1949. The report recommended completion of the remedial works to preserve and enhance the scenic spectacle and diversions of additional water for power.

This plan consisted of a new power plant located in the Niagara gorge above Lewiston opposite the Hydro Commission's Sir Adam Beck Station. This plant, indicated on Fig. 1 as "Proposed Lewiston Sta.," would utilize the full 314-ft head between the upper and lower Niagara rivers and have twelve 90,000-kw units or a total capacity of 1,080,000 kw. The waterways for the plant could be either two covered canals as recommended by the Power Authority, or three pressure tunnels as recommended by the Power Corporation. These are to be seen in profile in Fig. 4.

Since more water may be diverted for power during the night than during daytime hours, the plan proposed construction of a pumped storage project as first recommended by the Power Corporation. A large storage reservoir (shown in Fig. 1), with an area of 850 acres and a storage capacity of 22,000 acre-ft, would be located about one mile east of the Lewiston plant on top of the Niagara escarpment. The pumping and generating plant would have ten units aggregating 370,000 hp for pumping 32,000 cfs against a maximum head of 89 ft and 130,000-kw capacity when generating under an average head of 60 ft.

Water not needed for the Lewiston plant at night or over weekends would be pumped into the reservoir and released during daytime peak hours for use in the pumped storage and Lewiston generating plants. Water stored in the reservoir would be immediately available to provide any needed increase in generation, whereas water stored in Lake Erie by control works would require several hours to reach the generating plants.

The third unit in this plan would be the lower Niagara plant of 120,000-kw capacity, located adjacent to the Lewiston plant. The existing Schoellkopf Station develops about 215 ft of the total available head of 314 ft. This unit would reuse up to 18,000 cfs of water released from the Schoellkopf Station. It would operate under the remaining available 100-ft head with six 20,000-kw units having a total capacity of 120,000 kw.

Control works below the Peace Bridge at Buffalo were recommended as the fourth unit in the Federal Power Commission plan. A large storage capacity with insignificant changes in the level of Lake Erie would be made available by such control works. These works would add 180,000 kw to the dependable capacity and 73,000,000 kwhr based on storage confined to periods of one week. Seasonal and cyclical storage would have a great potential advantage, and further study of this phase of the plan was recommended.

Schoellkopf Hydroelectric Station of Niagara Mohawk Power Corp. develops power from flow of 20,000 cfs falling 220 ft. Photo courtesy N.M.P.C

Niagara Mohawk Power Corporation Plan—1950

The plans of the Power Corp. were in general similar to those of the Federal Power Commission except for the changes noted in Table 1.

TABLE 1. F.P.C. and N.M.P.C. Plans for Lewiston Station Compared

Feature	Federal Power Commission	Niagara Mohawk Power Corp.
Compensating works above Falls	No	No
Control works at Buffalo	Yes	No
Waterways	covered canals or tunnels	three tunnels
Lewiston plant	1,087,000 kw	1,350,000 kw
Pumped storage plant	130,000 kw	80,000 kw
Lower Niagara plant	120,000 kw	108,000 kw
Total capacity	1,330,000 kw	1,538,000 kw
Increase in annual output, billion kwhr	7.9	8.1

Power Authority of New York Plan—1951

During the period 1949–1951, the Power Authority of New York analyzed the solution proposed in the Federal Power Commission report and the changes in this plan made necessary by the terms of the 1950 Treaty. These studies assumed that the existing Schoellkopf plant, under license by the Federal Power Commission, would continue to have priority in use of water for power, that the new Lewiston plant would use the next available 48,000 cfs, and the existing Adams plant the remainder. Three computations were made, the Schoellkopf plant receiving 24,000 cfs (maximum capacity), 19,725 cfs (amount under permanent license), and 18,000 cfs (amount required for 25-cycle generators). The Lower Niagara unit would utilize 18,000 cfs except when this water was needed in the Lower Rapids to aid in ice flushing. No control works are provided in this or the following proposals.

New proposals were studied for a larger Lewiston plant (1,500,000 kw), which would receive all water available for power up to 65,000 cfs with the Schoellkopf and Adams plants utilizing any remaining water, in the order given. Three of the units would also have converters to change 60-cycle current to 25-cycle current to serve 25-cycle customers when the Schoellkopf plant is receiving insufficient water. The Lower Niagara unit would not be constructed since the capital cost of this unit as estimated by the Federal Power Commission would be about $400 per installed kilowatt. It would be more economical to construct a steam plant at half this cost, especially since the Lower Niagara unit would be inopera-

First power from Canada's 185-million, 700,000-hp Sir Adam Beck Station No. 2, under construction at left in photo, is scheduled for delivery in 1954. Existing 550,000-hp Sir Adam Beck Station No. 1 shows at right. Photo by courtesy of the Hydro-Electric Power Commission of Ontario.

tive when its water was needed for ice flushing.

Net project energy production, after deducting energy used in pumping water to the storage reservoir, varied from 11.1 to 12.0 billion kwhr under the Federal Power Commission plan and from 12.1 to 12.3 billion kwhr in the Power Authority proposals.

Additional plans were studied for a possible future development when control works are built at Buffalo or when the pumped storage unit could be greatly expanded to develop peak power only. The size of the pumped storage unit will of course be dependent on the size and method of operation of the Lewiston plant. Any plant at Lewiston should be designed so that it can be expanded to utilize all the water available in New York in one stage. It is assumed that the Niagara Mohawk Power Corp. would be assured all the power it now obtains from a diversion of 20,000 cfs, without increasing its present expenses.

Army Engineers' Plan—1952

A review survey report on redevelopment of the Niagara River for power was released by the Buffalo District Engineer's office in January 1952. The report was made following a resolution adopted June 5, 1951, by the Senate Committee on Public Works.

The Army Engineers' general plan for maximum development of power on the Niagara was divided into three general stages for construction: (1) initial development of additional waters (average of 47,300 cfs) made available by the 1950 Treaty; (2) redevelopment of 20,000 cfs originally available under the 1909 Treaty and now used by the Niagara Mohawk Power Corp. under license from the Federal Power Commission; and (3) storage in Lake Erie or on Grand Island for regulation of Niagara River flow.

The location of existing power plants and improvements considered are shown on Fig. 1. The recommended initial project would consist of an intake near Conners Island on the Niagara River; a single open unlined canal, 125 ft wide and 24,400 ft long, located generally east of the city of Niagara Falls; a 1,296,000-kw power plant near Lewiston; a 1,100-acre storage reservoir with a pumping (330,000-hp) and generating (270,000-kw) plant for daily regulation of flows; compensating (regulating) works located in the river just above the Falls; and all necessary relocation of utilities, highways, and other features.

Study of the second stage has not been completed. This stage might vary from construction of a Lower Niagara power plant, as recommended by the Federal Power Commission and the Power Corporation, to increasing the capacity of the Lewiston plant and eliminating the building of the Lower Niagara plant, as recommended by the Power Authority. Power Authority studies indicate that the latter scheme would produce a minimum of 365,000,000 kwhr more energy annually, on the conservative assumption that the Lower Niagara plant will never be shut down because of ice difficulties.

In the third-stage development dependable capacity of the entire project would be increased by storage of excess waters in Lake Erie by means of control works at Buffalo or by a reservoir on Grand Island. Preliminary estimates indicate a possible increase in peak capacity of 900,000 kw for the first and 450,000 kw for the second storage plan above. Either storage project would be supplementary to the pumped storage reservoir in the first-stage development.

Waterways in the initial stage will be large enough to carry the additional diversions available in the second or third stages. The forebay and power house are so designed and located that they can be expanded to handle any future increase in capacity. In addition to their higher cost as estimated in the Army Engineers' plan, tunnels would have an added disadvantage over open canals because of the complexity of the connections needed in expansion to the second and third stages.

Estimated capital costs were given in the survey report for seven different plans for the initial development. Costs for a three-tunnel waterway plan would be $87,537,000 more than for the open canal. From the standpoint of reliability, the Power Authority believes there should be more than one waterway because of the operating hazards involved in operation of such a large development. Estimates prepared by the Army Engineers for three of the plans are: a single unlined canal, 125 ft wide, $228,605,000; twin unlined canals, 80 ft wide, $320,662,000; and triple circular tunnels, 39 ft, $376,142,000.

Based on a total installation of 1,566,000 kw in the new plants, the capital cost for the single canal plan recommended by the Army Engineers is $185 per kilowatt, which compares favorably with present-day costs for steam-electric plants. Annual costs for the recommended plan were estimated at $13,780,000, based on 3 percent interest and amortization over a 50-year period. Total production from the Lewiston plant will be 8.621 billion kwhr annually. The annual energy loss due to operation of the pumping-generating plant is 10,000,000 kwhr, giving a net annual output for both plants of 8.611 billion kwhr. Existing plants would generate 2.660 billion kwhr additional. The at-site cost of the energy from the new plants, which was com-

puted on a 95 percent utilization factor, will be 1.6 mills per kwhr. It is small wonder that the federal government, the Power Authority, and five large privately owned electric utilities are striving to convince Congress that they should be the ones to redevelop Niagara.

The Army Engineers' estimate that power in the New York plant could be put on the line in about four years and the entire project completed in six years. Since orders for turbines and generating units now take about three years, a similar construction schedule would hold regardless of the agency authorized to redevelop the Niagara.

Status of Redevelopment

In ratifying the 1950 Niagara Treaty, the United States Senate appended a reservation, which in effect suspended the operation of the Federal Power Act. This reservation provides that no use shall be made of our share of the additional Niagara water without specific authorization from Congress. Were it not for this reservation, both the Power Authority and the Power Corporation could and would apply to the Federal Power Commission for a license to redevelop Niagara power. Under the long-established policy set forth in the Federal Power Act, the Commission would be required to give preference to New York State's application.

During 1951 both the Senate and House Committee on Public Works held public hearings on three bills embodying different proposals for Niagara redevelopment. These are, in the order of their introduction, (1) the Lehman-Roosevelt bill, (2) the Capehart-Miller bill, and (3) the Ives-Cole bill.

The Lehman-Roosevelt bill provides that the Niagara development shall be constructed by the federal government. Although this bill gives New York no control or voice whatever concerning construction methods or costs, and virtually no say in the planning, it does provide that New York may eventually be permitted to operate the project by paying all the expenses run up by the federal government and by complying with other unspecified conditions to be laid down in the future by federal officials.

It would require the State of New York to go into the power transmission business to a far greater extent than the Power Authority considers necessary or desirable. Furthermore, the Lehman-Roosevelt bill would require New York State to create preferred groups of customers for the cheap Niagara power, notably the consumers served by municipally operated electric systems and cooperatives.

But even if these conditions were accepted, New York State still would not get the Niagara power plant under this bill unless it agreed to other unspecified conditions to be fixed in a future agreement between the federal and state governments. If New York State does not reach an "agreement" with the federal government, the bill provides that Niagara power shall be marketed by the Department of the Interior.

The Capehart-Miller bill would turn the Niagara development over to a privately operated utility company. It has the strong support of five New York State electric companies, which propose to join forces and organize a company for the enterprise. The Power Authority opposed this as directly contrary to the long-established public policy of New York State—that its great water resources shall be kept forever in the possession of the people. This policy, which is embodied in the Power Authority Act, has been supported for many years by the governors, the legislatures, and the platforms of both major political parties in New York State.

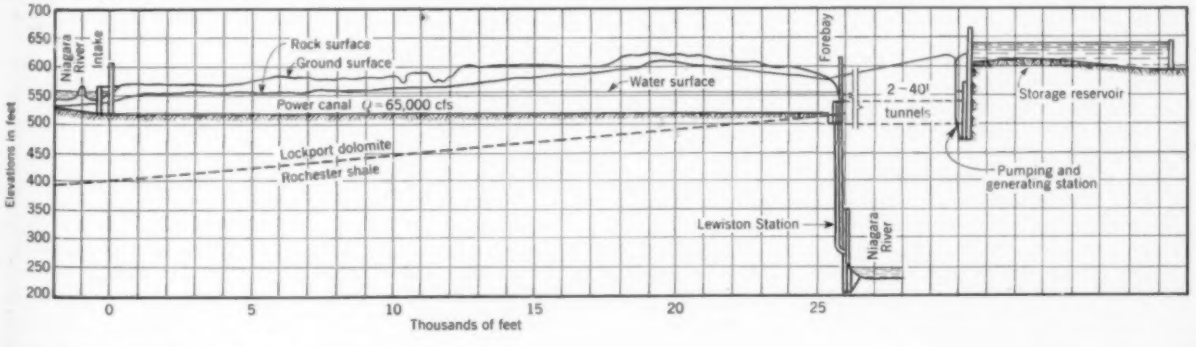
The Ives-Cole bill would authorize the State of New York to finance, construct, own and operate a project developing the additional power available from Niagara, subject to license and supervision by the Federal Power Commission and the engineering approval of the Army Engineers. The general engineering plan is the one published by the Federal Power Commission in 1949, and developed cooperatively by the Commission, the Niagara Mohawk Power Corp. and the New York State Power Authority.

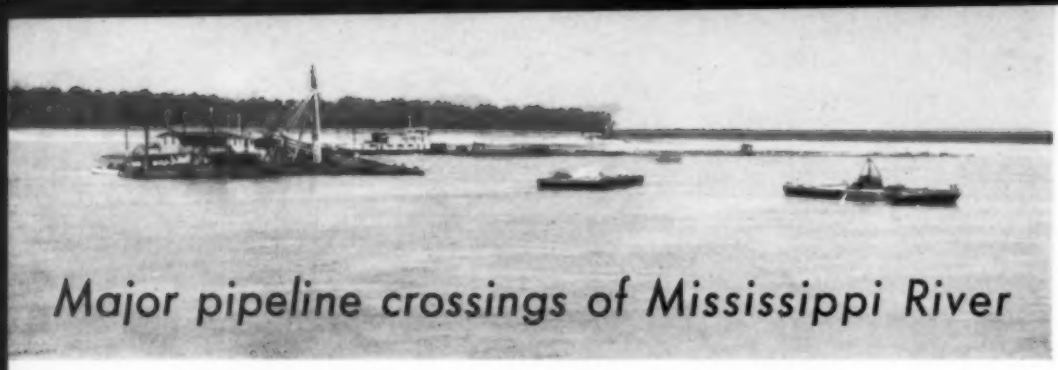
In addition to these assurances that federal interests will be protected, the bill further authorizes the Federal Power Commission to require that other states receive an equitable share of the power, and it approves a mechanism whereby such allocations may be establshed under interstate compacts.

Under this proposal the vast Niagara power development, including the remedial works needed under the treaty to preserve the scenic beauty of Niagara Falls, can go ahead without placing any burden on the already overloaded federal budget. The Power Authority is prepared to finance the development entirely from bonds which will be paid off from power revenues. At the same time, the people will get the benefit of at least 7.9 billion kwhr of cheap power a year, which is now being denied them.

Under the Ives-Cole bill, New York State would have full power to build transmission lines if necessary to protect the people's interest but it would not be arbitrarily required to enter into wasteful competition with existing systems. It would be able to give an even break to all consumers in the state, specifically including customers of municipal plants and cooperative systems, but would not be required to practice favoritism toward publicly or cooperatively owned power systems.

FIG. 4. Proposed Lewiston Station includes intake canal (or tunnels), forebay, and pumped-storage reservoir, shown in profile.





Major pipeline crossings of Mississippi River

Pipeline crossing Mississippi River is laid from steel work barge. Small winches on floating barge (foreground) slowly lower welded sections of pipe to river bottom.

Beginning in 1929 a series of multiple pipeline crossings have been constructed at Fitler Bend on the Mississippi River about 30 miles above Vicksburg. By 1949 a total of 26 lines had been laid at this location, and after last year's high water only 6 remained in service. Following two more breaks in March 1951, extensive investigations were undertaken to determine the causes of failure and to design a new crossing.

The locations of the center lines of these multiple crossings are shown in Fig. 1. Pipe sizes are mostly $10^{3}/_{4} \times {}^{3}/_{4}$ in. Some lines were bowed upstream while others were bowed downstream, with curvature more or less uniformly distributed throughout their lengths.

Along the west bank lies a wide and rapidly accreting bar which is completely submerged only at bank-full stages. The low-water line on the west bank has shifted eastward at an average rate of about 150 ft per year during the past 30 years. The east bank is under heavy attack, and revetment in the vicinity of the bight was commenced in 1907. Accelerated recessions below the revetment have attained rates of 300 to 400 ft per year at certain locations. Extreme instability is characteristic of this entire section of river.

All known breaks occurred on the east side generally within 600 to 800 ft of the high bank. This places the breaks at the thalweg or in the deepest water where maximum velocities occur. On revetted banks the breaks are approximately at the toe of the articulated concrete mats. These failures are believed due primarily to the following causes:

1. Scour. Scours of 40 to 50 ft in depth may be concentrated in a narrow bottom 600 to 700 ft in width within a few hundred feet of the east bank. As the pipelines were laid with the customary upstream or downstream catenary, with curvature more or less uniformly distributed across the stream, they do not have sufficient slack to conform to the deep scours at this location. The principal reason for bowing the lines is to provide slack. The futility of uniformly distributing slack over 6,000 ft of line is obvious when it is realized that the damaging scour is generally concentrated over only about 700 ft of line.

2. Hydrodynamic forces. No sound basis has been observed for determining the proper weight of line or so-called negative buoyancy. Negative buoyancies have been arbitrarily adopted and values as low as 1.2 have been used. A negative buoyancy of 2 was used uniformly from header to header on the lines laid at Fitler Bend. As the hydrodynamic forces at this location under conditions of maximum turbulence cause an uplift in excess of the hydrostatic buoyancy, a negative buoyancy of 2 is inadequate to prevent these lines from being projected upward from the bottom in the vicinity of the thalweg.

The lines will by no means rise to the surface. Hydrodynamic uplift varies with depth and hence vanishes at the surface. It is maximum at the thalweg and decreases toward the banks in accordance with variations in velocities. The periodic oscillations in intensity of these dynamic forces, combined with the hydrostatic pressures, produce sinuous wave motions in an inadequately weighted line with possible increased amplitudes due to resonance. These vibrations cause rapid fatigue or crystallization of the metal and ultimate fracture.

The lines laid at Fitler Bend not only do not have sufficient weight to withstand the hydrodynamic uplift at the thalweg, where maximum turbulence occurs, but are heavier than necessary at certain other locations. Weight as well as slack should not be distributed uniformly throughout the line but should vary in accordance with the resultant of the dynamic and static uplifts.

3. Density. During critical periods of high turbulence, the density of the water at the bottom of the channel due to the suspended and bed-load materials is well in excess of that of fresh water upon which negative buoyancies are normally, and therefore incorrectly, based. As bed loads respond instantaneously to changes in velocity, the resulting density varies accordingly. It is therefore maximum at the thalweg and minimum at the bank on the bar side of the channel. Variation in density is another factor that must be taken into account in determining the proper weight of line at any point.

4. Caving banks. Receding banks constitute a major hazard to pipelines unless proper precautions are taken. At Fitler Bend the caving takes place in the upper part of the east bank, which is mostly loam and which sloughs off almost vertically after the lower part, consisting of saturated sand, flows out from beneath. As the caving part of the bank lies above the low-water plane, the pipelines should be laid in open trenches excavated to approximate low water. Although the trenches will fill during high stages, the material will be mostly sand. It will be relatively free of loam and therefore of a tendency to cave. Accordingly, it is not believed that the current and costly practice of excavating banks similar to those at Fitler Bend to considerable depths below low water is justified.

5. Concrete revetment. The Fitler Bend revetment consists of articulated concrete mats laid on the east bank and extending to the thalweg (Fig. 1). As the mat offers greater resistance to scour than the river bottom, deep holes may be cut at the toe. A pipeline laid across the mat is suspended between points of contact and at the toe and is thus exposed to everything the river can throw at it. The swaying of the pipe causes impacts and abrasions at the point of contact with the mat. Furthermore, the mats are known to flutter at the toe with extreme turbulence. Hence, not only do the pipes pound the mats but also the mats

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How to choose a site

pound the pipes. In view of the foregoing, the laying of pipes across concrete mats is not recommended.

In selecting a new site for a pipeline crossing in the vicinity of Fitler Bend, existing conditions were of course considered but far greater importance was attached to a proper evaluation and analysis of the changes that might take place within the economic life of the crossing. Considerable time was spent in studying available records of this entire reach, including hydrographic and topographic surveys, discharge data, and geological information on the banks and bed of the river.

Composite profiles and shore lines were compiled and studies were made to relate all changes to natural migrations or to artificial causes. Improvements affecting this reach of river such as cutoffs, revetments, and dredging were studied to determine the changes actually resulting therefrom. Only by means of such background information can a reasonable forecast be made as to future changes that can be anticipated at any given site.

Although extreme instability is generally characteristic of this entire section of river, a site was found which has been relatively stable for a number of years and which possible future changes indicate to be less hazardous than other locations. This site is three miles below the old crossings at Fitler Bend (Fig. 1) and one mile above Cottonwood Bar.

To provide better channel easement and to alleviate heavy attack on the west bank below Cottonwood Bar, dredging of a channel westward of the bar was started in 1937. This artificial shifting of the channel to the west side of the bar and its maintenance by annual dredging has counteracted the accretions of the bar along the west bank and thereby has not only stopped the attack on the east bank at the site of the crossing but has also caused considerable shoaling in front of this bank. Because of the wide, flat and shallow bottom at this location, velocities are considerably less than at Fitler Bend and nowhere in this region do comparable scours take place.

Having selected the crossing, further studies were made to determine the nature and extent of changes that could reasonably be expected within the next 25 years. It is firmly believed that a design of any crossing of a meandering stream within an alluvial valley which is not based on such considerations invites sudden disaster. It is also firmly believed that many of the twenty lines abandoned at Fitler Bend would not have failed had they been laid at this new site, in view of the highly favorable conditions that have existed here during the past thirty years.

A look at the future is by no means so encouraging. The principal changes that might occur at this crossing depend upon whether or not the Fitler revetment is extended. In either case the resulting changes would be accelerated and intensified if maintenance dredging should be discontinued west of Cottonwood Bar.

Consideration had been given initially to the utilization of a crossing consisting of two large-diameter lines dredged below bottom scours and into the east bank beyond the extent of recession. However, after a little study of the characteristics of this reach of river, it appeared increasingly hazardous to base a design on any such rigid assumptions. With a number of smaller lines, one and possibly more breaks can be provided for with considerably less excess capacity and correspondingly less additional cost.

The new crossing as designed and constructed is shown in Fig. 1. The lines are laid straight from the header on the Louisiana side across the accreting bar to areas where appreciable scour begins to take place on the channel side of the bar. The amount of slack is increased from an offset of 100 ft in 600 ft to 150 and 200 ft in 600. It is estimated that the 200-ft offset will accommodate a scour of about 75 ft in 600, which is well in excess of any that can reasonably occur at this location.

The maximum slack is used where maximum scouring can be expected, and is carried across the bank on the Mississippi side to the vicinity of the headers to provide for the recession of the bank. The Mississippi header is located about 1,200 ft from the present bank and behind the ten-year bank line; it can be moved further eastward when and if bank recession requires.

Five different weights of line are used to offset the varying uplifts and densities. The ticks indicate where changes in weight are made. The minimum weight is used on the Louisiana bank and on the high part of the bar adjacent to that bank. The maximum weight is used where maximum turbulence can be expected and is carried across the Mississippi bank to the vicinity of the header. If the Mississippi header is moved back, the same slack and weights will be extended to the new header.

For protection against caving banks, the Mississippi bank was trenched along the axis of the lines. The trench extended down to about the low-water plane and backwards to a point 200 ft from the top of the high bank.

The six downstream lines are $10^3/_4$-in. O.D. with a $^1/_2$-in. wall thickness on the bar, and $^3/_4$-in. in the channel. The seventh line is $12^3/_4$-in. O.D. pipe with a $^1/_2$-in. wall thickness. Cast-iron clamps of 400 and 1,000 lb are used on the $10^3/_4$-in. lines and 1,800-lb clamps on the $12^3/_4$-in. line. The $10^3/_4$-in. pipe was used because it was either on hand or on order. Otherwise, the $12^3/_4 \times {}^1/_2$-in. pipe would have been used for all lines as it is equally, or more, satisfactory in every respect. It not only has almost twice the capacity of the $10^3/_4 \times {}^3/_4$-in. line, but it weighs 15 lb per ft less and costs no more to lay.

Two other features of this crossing may be of interest. One is the long-range river-stage forecasting service

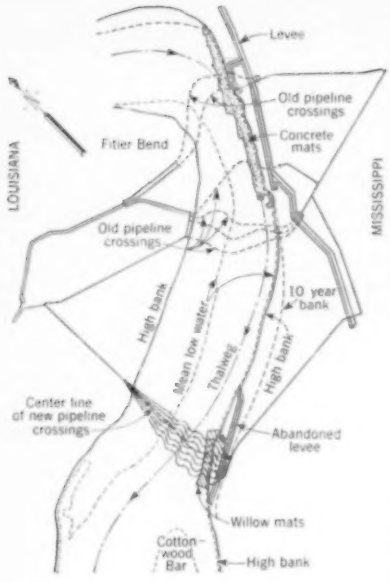

FIG. 1. Many failures in pipeline crossings at Fitler Bend, on Mississippi River about 30 miles above Vicksburg, led to choice of new site for multiple crossing three miles below, about one mile above Cottonwood Bar. Five different weights of pipeline are used at new site. Ticks indicate points where changes in weight occur.

which was worked out with and provided by the U. S. Weather Office in Vicksburg. Probably no construction work is more sensitive to changes in river stages than a pipeline crossing. Not only was considerable lost time avoided due to timely warning of impending high stages but the final decision to shift the crossing to Cottonwood Bar was based on a long-range forecast that sufficiently low stages would probably not exist to permit the construction of a crossing at Fitler Bend.

The other feature was the method of orientation. Positions in the river were obtained by resection from three points ashore with a three-arm protractor. Angles were read with a sextant, and five targets were established which would permit sufficiently strong resections from at least three of the targets at any position in the river. This method afforded a rapid, precise and simple system of orientation which proved far more satisfactory than any used for previous crossings.

The foregoing analysis and design was derived with an open mind and without prejudice against either a multiple crossing or a large-diameter crossing dredged beyond estimated scours. The latter type of crossing was initially considered in line with the trend of present practice, but was rejected for this site for the following principal reasons:

1. A large-diameter line with heavy wall thickness and encased in concrete is inflexible and must be buried beyond possible scours.

2. Not only is a continuous history of scour not available at crossing sites but such intermittent surveys as are obtainable may be misleading, and accordingly future estimates must necessarily be highly uncertain. The degree of such uncertainty is directly proportional to the probability of failure.

3. Disregarding the astronomical costs, the limitations of even the most powerful dredges would not permit burying the line beyond scours and erosions believed possible at the Cottonwood site. A compromise based on the assumption that continuous observation, especially under severe conditions of flood and drift, would permit further dredging in time to prevent failure borders on wishful thinking. Not only are observations difficult under such conditions, but work could not be undertaken at best until the following low-water season.

(This article represents a shortened form of the paper presented by General Timothy before a Construction Division session, presided over by Ross White, at the ASCE New Orleans Convention.)

How to build and maintain a crossing

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Since the early 1920's, oil and gas companies have been faced with the problem of making major pipeline crossings of the Mississippi River. As a result of failures across smaller high-velocity streams, it was naturally believed that failures across the middle and lower reaches of the Mississippi were to be expected periodically and that the best way to insure uninterrupted service was to substitute for one single pipeline several smaller lines having a total capacity equal to or greater than the main line. If one or even two failed, service could still be maintained while repairs or replacements were made. This view is still held by some companies. The trend continued through the 1930's and up until the end of World War II, although there was little activity in this field during the war years except for the war emergency pipelines across the upper reaches of the river.

During these twenty-odd years everyone concerned knew that vibration of the pipe, resulting in metal fatigue, caused pipelines to fail in major stream crossings. There was great emphasis, however, on holding pipeline construction costs to an absolute minimum and this contributed to the conclusion that thorough engineering investigation and design, which might prevent or reduce failures, was too expensive and not worth while.

Beginning about 1945, however, the need for huge expansion in the pipeline transportation industry brought about a change in this trend. A boom condition developed rapidly and has continued fairly steadily through 1951. Since the need was for transportation of much greater volumes of natural gas as well as crude oil and its products, pipelines of larger diameter were needed.

Before 1940, pipe sizes generally ran from $6^{5}/_{8}$-in. O.D. × 0.28-in. wall thickness to $12^{3}/_{4}$-in. O.D. × 0.375-in. wall thickness. This pipe was usually fabricated from mild steel of about 40,000-psi yield point and conforming to API Standard 5-L. In the early days, pipe

Derrick barge with 150-ft boom and 50-ton capacity handles pipe on work barge. Derrick lifts pipe when work barge is pulled ahead one pipe length. Last completed weld is then at stern of barge where it is inspected and coated while next section is being welded in position.

was threaded on the ends and screwed together by threaded couplings, but later on in the 1930's pipe was beveled at the end for welding and was welded first by the oxy-acetylene process and later by electric arc.

Additional weight to counteract buoyancy and reduce vibration was provided by bolting cast-iron clamps around the pipe at each threaded collar or welded joint. A protective coating was generally used, consisting of asphalt with felt wrapper or some type of grease compound.

In the early days preliminary design work to determine location and grade was usually rather sketchy. The general location was, of course, dictated by the route of the line. It was customary to reconnoiter the general location and select a site where the river banks showed evidence of the least erosion and were of uniform slope and on a natural grade which would allow the pipe, through its own flexibility, to conform to the river bottom. It was usually necessary to excavate the banks to some extent to maintain this grade but such excavation was held to a minimum. Usually no thorough effort was made to determine the scouring characteristics of the bottom or the history of bank erosion.

It was considered desirable to cross the river where the waterway was as narrow as possible. The cast-iron clamps which provided additional weight were installed to reinforce the strength of the screw or welded joint as well as to add weight. Little attempt was made to design against buoyancy by considering current velocities and the weight of silt-laden water.

Many failures have occurred in these pipeline crossings. About 70 percent of those installed as described above have failed at least once and some several times. When large-diameter pipelines came into the picture about 1945, the industry as a whole was quick to realize that the crossing of major streams, especially the Mississippi, was a problem on which little progress had been made. So the pipeline companies and associated engineering organizations turned their thoughts toward eliminating the causes of failure.

The first step was to try to determine the amounts and frequency of the change in the river bottom contour as well as the characteristics of bank erosion in the general area of the proposed crossing. The principal source of this information is the U. S. Corps of Engineers District headquarters at Vicksburg, Miss. It should be pointed out, however, that the U. S. Engineers should not be expected to furnish infallible predictions as to what the river will do. They can and will work with everyone concerned with pipeline crossings, but their data must be interpreted and decisions made by the pipeline company.

Even when all the available data had been assembled, pipeline engineers had only a general idea as to how much and how frequently the river bottom changed, but at least they were impressed with the magnitude of the change. The next step was to decide what was the best way to combat this condition and this subject is quite controversial. Opinions and practices are pretty well divided into two groups.

1. Those who still think that it is best to lay multiple small-diameter lines, not attempting to bury them under the bottom, but with various designs as to counterweighting and alignment to provide slack and thereby eliminate or reduce vibration.

2. Those who think that two or possibly three larger-diameter lines are best and that they should be buried below the river bottom as well as counterweighted to eliminate or reduce vibration.

Some of the older pipeline companies make up the first group, while the second is composed mostly of the new gas companies, with the practices of which we are here concerned.

When costs were estimated, they were of course found to be far in excess of those for the older crossings and this led to consideration of the construction of overhead crossings supported by a suspension bridge. Such overheads are used frequently on smaller major streams, but their cost across the Mississippi was found to be so much greater than the proposed submarine design, that to date none have been built. Some thought was given to the possibility of several companies crossing at the same location and jointly constructing a suspension bridge, but the wide variation in routes and other factors made this impractical. One of the major gas transmission companies arranged to suspend its lines on the highway bridge near Greenville, Miss., at the time its main line was constructed in 1944 and has since expanded its system until it has both overhead and submarine crossings in operation at this site.

After the basic design was adopted, extensive field work was required to establish the grade under the river bottom and below the banks. It has been the practice of some companies to take soundings at low-water stage because they believe that scouring at their particular location occurs at low water. Other companies have taken initial soundings at high-water stage by means of an electronic fathometer because they believe scouring occurs then. Either practice determines the approximate

true scour grade provided the assumption is correct as to when scouring occurs at the location in question.

The depths to which the more recent crossings have been buried under the supposed scour depth have varied from 10 to 30 ft. This grade has been established by two factors: (1) the net change in the river bottom between scouring and silting up as reflected by available records, and (2) the limitation on dredging depth. The most powerful dredges operating on the Mississippi can only dredge to a total depth of about 50 ft, and the river is usually from 20 to 45 ft deep at mean low water.

Some companies stay with the idea that the crossing should be located at the narrowest point available so that they will have only a short distance to worry about. The matter of laying a pipeline with an upstream or downstream bow is also controversial. Both practices have been followed for many years and preferences are about equally divided. The idea is, of course, to provide additional slack so that the pipeline can conform to the new bottom if scour occurs. There is a third group who feel that burying the pipeline below the scour depth makes either an upstream or a downstream bow of little value. They lay theirs straight and concentrate on keeping the lines buried.

Since 1945, the major pipeline crossings of the Mississippi River have been from 16 to 24-in. O.D. and have been mostly dual lines. The pipe has been mostly $^1/_2$-in. wall thickness and its dead weight alone is from 83 lb per ft of length for the 16-in. to 125 lb per ft for the 24-in. Steel used in the pipe is usually about 40,000 psi. Some companies have used steel reinforcing sleeves welded to the pipe to add strength to the welded joint. All welding is by the manual electric-arc method.

Protective coating is used and usually consists of a double hot application of coal-tar enamel wrapped with fiber glass and coal-tar-impregnated asbestos felt, although the Somastic type is also used. Additional weight is provided by a concrete overcoat applied over the protective coating, the thickness of the overcoat depending on the additional weight desired. The gas companies generally use enough weight to offset the buoyancy of the empty pipe in silt-laden water, which weighs about 80 lb per cu ft, plus from 20 to 30 percent for safety. The oil companies use a lower safety factor, or about 10 percent, since they have the weight of the fluid for added safety, but they cannot disregard buoyancy as it is always possible for an air surge to occur in an oil pipeline. The concrete overcoat is applied either by spraying, as in gunite, or by molding, and is reinforced by some type of wire mesh.

Since major pipeline crossings of this design have only been in service a few years, there is not a great deal to report as to the results attained. There have been only two failures. One of two 20-in.-dia oil lines installed in late 1949 failed after 18 months of service as the result of a scour. The cause of the scour is in itself interesting since these lines were well buried below normal scour depth. A few months before these lines were laid, the U. S. Engineers installed revetment along the east bank which ended about 2,000 ft upstream from the pipelines. During the next several months this revetment was washed out. The subsequent change in the direction and velocity of flow along the east bank, as well as the decreased velocity at the pipeline location, caused turbulence resulting in a deep hole under only one of the pipelines, the two lines being about 150 ft apart at this point. The other failure, in one of two 24-in. gas lines installed in 1950, was due to faulty materials, not river action.

Construction Methods Outlined

Construction methods and equipment that have been used on the larger-diameter pipe are much the same as on the smaller except that everything is necessarily larger and heavier and more forethought has been given to unexpected contingencies. The contractor's marine equipment should be larger and more powerful than he expects to need under low-water conditions so that he can successfully combat any unexpected behavior of the river. Dredging of the channel requires a powerful suction dredge capable of moving about 2,000 cu yd per hour as well as of dredging to a finished depth of 50 ft and of withstanding the river currents.

Pipe and other materials are usually assembled at a central location either on the river bank or at some point accessible to water transportation. Then the protective coating and the concrete overcoat are applied and the pipe is welded into sections from 120 to 200 ft long. After the sections are tested either hydrostatically or with compressed air, the welded joints are coated and the pipe is loaded on barges for transportation to the job site.

Laying of the pipe follows as closely behind dredging as river traffic and safety considerations will permit. The pipe is laid from a steel barge known as the "work barge," which is at least 200 ft long and about 40 ft wide. A sloping ramp is built in the center of the barge on which a section of pipe is laid for welding to the previous section. The pipe is handled by a 40- to 50-ton derrick barge equipped with a 150-ft boom. After a section is welded on, the work barge is moved ahead by using power winches and tugboats while the derrick raises the pipe and allows it to slide down the inclined ramp into the water.

Since the move ahead is only the length of the section, the recently completed weld is then at the stern end of the work barge, where it is inspected and coated while the next section is being welded on. The sloping alignment of the pipe from the stern of the work barge to the bottom of the excavation is maintained by holding the pipe up with two or three power winches mounted on smaller barges, and lowering to the bottom progressively. A continuous check on the excavation and pipe alignment is maintained by fathometer readings.

There are now five major crossings in service in the section of the river between Helena, Ark., and Baton Rouge, La., which have been buried below the river bottom at varying depths and conform generally to the principles of design discussed herein. No one will try to predict what will happen to these crossings even in the near future. All agree that the basic operating principles to follow are to try to stay out of the way of the river and not to expect to beat it with one installation.

No submarine pipeline crossing of the Mississippi can be considered as a permanent installation regardless of how it is installed. A constant watch must be maintained on the bottom and bank contours and the necessary money must be spent every year to lower the lines, if required. Scours do not form overnight, and by maintaining a frequent check with electronic depth recorders, especially during high water, they can be detected in a formative stage. The lines can then be lowered as soon thereafter as the water stage permits.

(This article is a shortened form of the paper Mr. Gregory presented before the Construction Division session, presided over by Ross White, at the ASCE New Orleans Convention.)

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Welded design was used on 16-story building erected on Capitol and Travis Streets in Houston, Tex., in 1950. Careful welding procedure reduced welding rod per ton of steel to 4 lb, and movement of exterior wall columns due to shrinkage from welding to about 0.25 in.

Welded multi-story structures save steel and money

Structural welding made considerable progress during the second World War through its extensive application in shipyards. However, the general adoption of welding in structural fabrication and erection has been limited by two chief conditions: (1) the unwillingness of many fabricators to scrap good, usable equipment and a shop-wide, familiar method of riveted fabrication, purchase new welding equipment, and spend the time, effort, and cash necessary to successfully develop welding techniques in their fabricating shops; and (2) the persistent indifference and evident ignorance of many structural designers of the great possibilities inherent in structural welding.

Modern flame cutting and welding permit the wide-awake, alert structural designer to develop simple, effective details which would have been totally impossible a very few years ago. Savings in cost of construction up to 15 percent can be realized in many structural designs by the use of welding.

"Locked up" stresses of unknown magnitude are frequently offered as an excuse for not using welding in structural design. Later discussion will show that welding stresses of considerable magnitude and of the proper kind can be developed which will carry a part of the floor load stresses, an accomplishment that cannot be duplicated in riveted construction.

Effective welds must have a penetration into the parent metal roughly proportional to the size of the weld. This penetration may vary from a minimum of $^1/_8$ in. for small welds to $^1/_2$ in. or more for the larger welds. This penetration requires sufficient heat to produce molten metal at the point of welding in the parent metal, usually a temperature of about 2,600 to 2,770 deg F. Such heat will produce marked distortion in the metal, and if welds are made on one flange of a column only, a force of great magnitude will be developed above the weld. This force in many instances is of sufficient magnitude to snap a $^3/_4$-in. plumbing cable, and therefore it is very difficult to keep a building frame plumb if welds are made on one flange of a column at a time.

This difficulty can be easily overcome by working welding operators in pairs and insisting that the welds on both flanges of an interior column be made at the same time. If this procedure is followed there will be a slight vertical movement of the column at the welding point, but there will be no lateral force developed at the floor above to throw the building out of plumb. Opposite exterior columns should be welded at the same time, so as to balance the distorting forces.

Distortion of the building frame is due entirely to the effects of the heat induced by welding. The magnitude of this distortion is roughly a function of the amount of the heat and the length of time over which it is applied. A large amount of heat applied to a panel point in a relatively short time will cause much greater distortion than the same amount of heat applied in increments over a much longer period. Therefore, to minimize the distortion of the building frame as much as practicable, the welding at a given panel point should be performed in three separate operations, with the time interval between the operations such as to permit complete dispersion of the heat developed by one operation before the next operation is started.

The small additional cost of doing the welding in three separate operations is fully justified by the far better results attained. Now assume that the top 6 in. of the $^3/_8$-in. fillet shear welds are all made on the first day, and that the top flange welds are all made on the second day. This will allow the complete dispersion of the heat and will rigidly tie the floor framing at the top flange level in both directions. The third and fourth welds are to be made on the third day.

Shrinkage of the bottom flange welds and of the parent metal of the bottom beam flanges and the column due to the high temperatures developed in them by the welding operations will cause tensile stresses of considerable magnitude in the bottom flanges of all beams framing into a column. Top flanges are rigidly attached to the columns and are not affected by the heat from Weld No. 3. When tension is developed in the bottom flange by the shrinkage of the metal, a corresponding stress in compression will be developed in the top flange of the beam, which will produce a definite downward deflection at the center-line of the beam. Since these stresses are exactly opposite to the beam stresses at the columns produced by the floor loads, the stresses produced by the field welding can definitely support a considerable part of the floor loads.

Stress of 4,350 Lb Developed

Careful measurements to determine the magnitude of the stresses produced by field welding were made in a building on Texas Avenue, in Houston, Tex. This building was erected in 1950. In these observations, an average stress of 4,350 lb was developed in the top and bottom flanges of the beams by the field welding. This indicates that about 40 percent of the floor loads would be carried by the field welding stresses in this case. More accurate and improved methods are to be used to determine the magnitude of these stresses in future buildings erected under the writer's supervision.

A modern office building requires extensive electrical service of three kinds—light, telephone and business machine connections. Changing tenants and shifting of equipment for long-term tenants makes the resulting shifting of electrical outlets a serious problem. This service cannot be rendered by any type of concrete floor construction where the electric conduit is placed in the structural concrete or in the floor fill. The most effective solution is to use the modern cellular type of metal floor construction. This consists of hexagonal-shaped continuous cells, each $3^1/_8$ in. high, spaced 6 in. on center, and weighing from 5 to $7^1/_2$ psf. Each cell forms a channel or raceway for electrical wiring, and an outlet can be provided at any point on the floor within an area that can be covered by a half-size sheet of letter paper.

This type of floor construction reduces the floor dead load from 25 to 35 psf and shortens the period of construction by from three to five months, depending on the size and height of the building. The savings realized in the structural frame and foundations on account of the decreased dead loads, plus the three to five months of extra revenue from rentals, offset the extra cost of the cellular-type flooring. As a result, this high degree of flexibility in the location of electrical outlets can be had at practically no extra cost to the owner.

Basic Factors in Good Welding

There are five very essential elements of about equal importance in securing a satisfactory welded job:

1. Careful and accurate shop fabrication by a contractor with experience in the fabrication of welded structures.
2. Erection by a contractor with experience and good equipment suitable for this type of construction.
3. A field welding procedure which has been carefully tested and found satisfactory for the type of work involved.
4. Reliable field inspection by a recognized testing laboratory employing competent and experienced personnel.
5. Carefully qualified welding operators.

Welding operators should be qualified, in accordance with the Standard Qualification Procedure developed and recommended by the American Welding Society, by an engineer representing the testing laboratory, who is in continuous daily contact with the field welding operations. The qualification test specimens consist of the two 5 × $^3/_8$-in. plates 10 or 12 in. long, with a 2 × $^3/_8$-in. back-up plate of the same length assembled so that the two 5-in. plates are exactly $^{15}/_{16}$ in. apart and are tack welded to the back-up plate. A $^3/_8$-in. fillet weld is placed along the edge of each 5-in. plate, one specimen being welded in a vertical position and the other in a flat or horizontal position. Then the remainder of the $^3/_8$ × $^{15}/_{16}$-in. space between the two 5-in. plates is completely filled with weld metal while in the horizontal position. The $^3/_8$-in. back-up plate is then milled off, and the weld metal is ground smooth with the surface of the 5-in. plates.

The specimens are now flame cut into strips and prepared for the bending tests which will reveal the soundness and ductility of the weld metal. A direct standard tension test on the weld metal can be made if specified by the designing engineer. The writer believes that this tension test is of sufficient value to warrant making it and keeping the results as a

Table I. Amounts of steel in typical building panel compared for welded and riveted construction

Structural Sections*	Weight, Lb
18 WF 50 × 39′ 0″	1,950
18 WF 55 × 39′ 0″	2,145
18 WF 70 × 24′ 6″	1,715
24 WF 110 × 13′ 6″	1,485
24 WF 120 × 16′ 4″	1,960
14 WF 211 × 12′ 0″	2,532
Total structural sections	11,787

* Same for welded and riveted construction.

All-Riveted Design

Details	Weight, Lb
12 ∠ 5 × 4 × $^3/_8$ × 0′ 11$^1/_2$″	105
4 ST 18 WF 150 × 1′ 2$^1/_2$″	725
4 ST 18 WF 140 × 1′ 0″	560
4 ∠ 8 × 8 × $^3/_4$ × 0′ 8$^1/_2$″	110
Rivets	288
Total riveted details	1,788
Total structural sections	11,787
Total for riveted design	13,575
Percentage of details to total	13.17

All-Welded Design

Details	Weight, Lb
1 Pl 4 × $^3/_8$ × 1′ 7″	14
1 Pl 4 × $^1/_2$ × 1′ 7″	12
4 Pls 8 × 1 × 1′ $^1/_2$″	113
2 Pls 8 × $^7/_8$ × 1′ $^1/_2$″	50
2 Pls 12 × $^1/_2$ × 1′ 5″	58
12 ∠ 5 × 4 × 3$^1/_2$ × $^1/_4$ × 0′ 11$^1/_2$″	105
Weld metal	34
Total welded details	386
Total structural sections	11,787
Total for welded design	12,173
Percentage of details to total	3.17

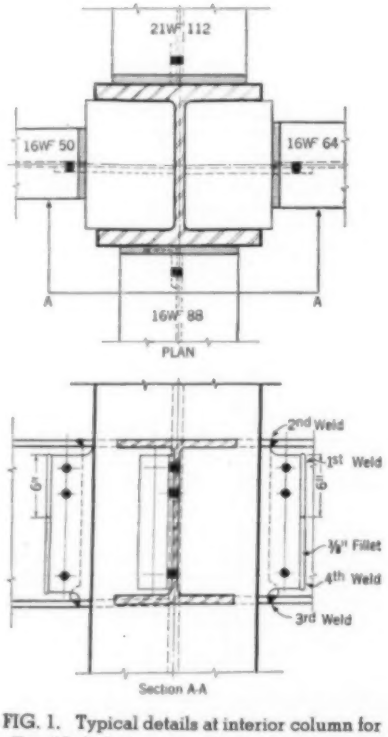


FIG. 1. Typical details at interior column for all-welded design are shown in plan and cross section. Sequence of weld is indicated.

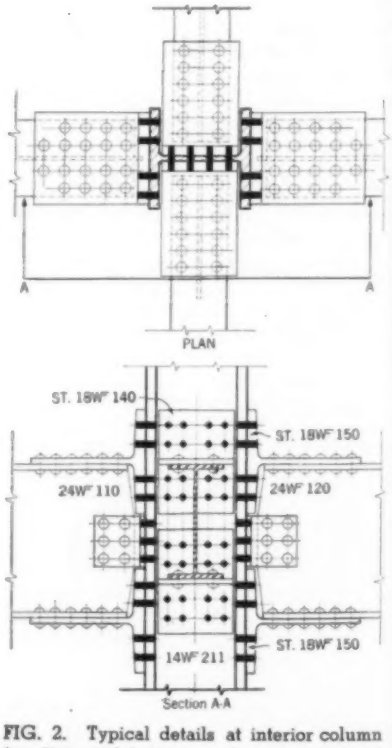
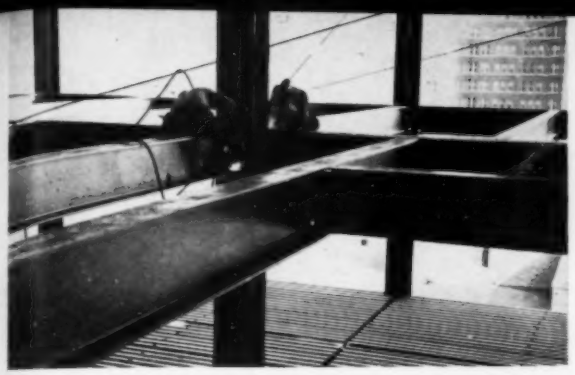
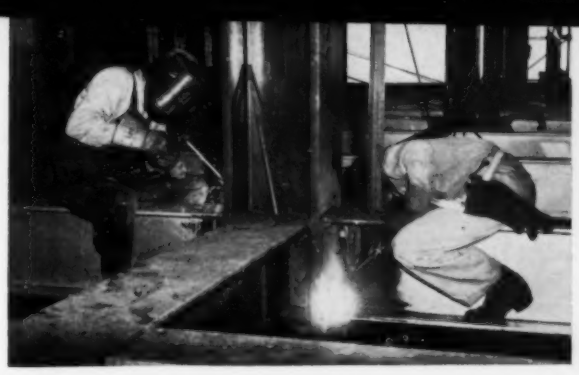


FIG. 2. Typical details at interior column for all-riveted design are shown in plan and cross section.



Difficulty of keeping building frame plumb during welding is removed if welders work in pairs, making welds on both flanges of interior column at same time. Slight vertical movement of column due to welding will not be serious. Cellular-type metal flooring, seen below, is easily adapted to welded type of structure.



Welded column connection is accomplished in three separate operations: (1) top 6 in. of web weld; (2) top flange weld; and (3) bottom flange weld and remainder of web weld. See Fig. 1. By allowing 12 hours between these operations, distortion due to high welding temperatures is minimized.

part of the permanent job records at the testing laboratory.

The effectiveness of the field welding procedure suggested is indicated by the following facts. On a 24-story building 252 ft long erected in Houston, Tex., in 1946, the horizontal movement of the exterior wall columns due to shrinkage from the welding of the floor system was approximately 1.5 in. On the building of exactly the same length, erected in Houston in 1950, the movement of the exterior wall columns due to shrinkage from the welding was about 0.25 in., or one-sixth of that in the previous case. Also, the field welding on the first building required about 14 lb of welding rod per ton of steel, whereas on the building erected in 1950 only about 4 lb of welding rod was required per ton of steel, or less than one-third that used on the first building. Welding on the first building was carried out with no regard for shrinkage problems, whereas on the second building referred to the methods previously outlined for controlling shrinkage and stresses due to high welding temperatures were rigorously adhered to.

Comparative Costs Studied

To determine the comparative costs of all-welded and all-riveted construction for multi-story buildings, details for both types of design were developed similar to those shown in Figs. 1 and 2. A careful estimate was made of a typical floor panel, including an average sized column for a 12-ft 0-in. story height. Table I shows that the weight of the beams, girders, and one column, without details, for such a panel is 11,787 lb. Details for a riveted job totaled 1,788 lb, making a total weight of 13,575 lb for the all-riveted panel. Details for the all-welded panel weighed 386 lb, thus giving a total weight of 12,173 lb for the all-welded panel. For the riveted job, the weight of details constitute 13.17 percent of the total weight, and for the welded job, they constitute 3.17 percent. This is exactly 10 percent less than for the all-riveted job.

Applying these percentages to a welded job requiring 4,000 tons of steel, the excess weight of details that would be required if riveting were substituted would be 400 tons. Steel for all-welded multi-story buildings now costs about 9 cents per lb, or $180 per ton erected and field welded. The extra steel required for the riveted job could not be bought at the same price as the steel for welding because it requires much flame cutting and the drilling of many rivet holes. It will cost at least 11 cents per lb, or $220 per ton erected, making the additional cost for the riveted design $88,000. A completely welded job, using 4,000 tons, would cost a total of $720,000 erected. Therefore the excess cost of the riveted job over the welded job—which is inherently neater—would be 88,000 ÷ 720,000, or 12.22 percent.

But this is not the total additional cost for a completely riveted job using the cellular floor for the following reasons:

1. The connections for a riveted job extend about $1^5/_8$ in. above the top of the supporting beams for a distance of about 18 in. from the face of the columns. This requires much additional cutting and trimming of the cellular floor at all columns at considerable added cost.

2. Additional supports must be provided for the cellular floor at all beams adjacent to all columns.

3. All cells of the cellular floor within 24 in. of the center line of the columns, or for a total width of 4 ft 0 in. at each column line, are blocked and eliminated from use unless an expensive "jack header" is installed at each column. Considering all the special conditions outlined, the additional cost of a riveted job will be at least 15 percent greater than the cost of an all-welded job.

The building erected at Capitol and Travis Streets in Houston, Tex., in 1950, shown in the photographs, may be considered as typical. For it 2,274 tons of steel were required. The total floor area is 253,000 sq ft and the volume is 3,153,000 cu ft. The story height varies from 11 ft 0 in. to 16 ft 11 in., and averages 12 ft $5^1/_2$ in. The amount of steel required was 17.98 lb per sq ft of floor, or 1.44 lb per cu ft of building.

Column shafts without details totaled 745 tons, or 32.76 percent, very close to one third of the total steel. The columns plus details totaled 846.5 tons, or 37.22 percent, and the columns plus details plus column base slabs totaled 894.4 tons, or 39.33 percent of the job. The column details amounted to 13.62 percent of the column shaft weight, or 12 percent of the total column weight. Job details amounted to 6.48 percent of the total tonnage.

For the shop fabrication, 14,844 lb of weld metal was required. The greater part of the details are on the columns, and 18.45 lb of weld metal per ton of column shaft was used for shop fabrication of the columns. Some three-plate special beams used for spandrel beams required 32.6 lb of weld metal per ton of beams. Trussed spandrels with narrow flanges were required to meet the architectural conditions at two of the floors. These trussed spandrels required 16.77 lb of weld metal per ton for shop fabrication.

A total of 9,210 lb of welding rod was used for the field welding. This is 4.05 lb per ton on the total job tonnage, or 12.36 lb per ton of column shaft weight.

Introducing a new feature: **How would you do it?**

The unexpected

Some introductory comments relating

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In any engineering project there will be bugs, swarms of them. From the inception to the demolition of a project the engineer must be alert to every one which might interfere with utility, appearance, safety or soundness. Regardless of the origin of the difficulty, if it jeopardizes any important phase of the undertaking it needs correction.

The ancients tried to build for eternity. The modern engineer has no such illusions—he builds only for a short span of time bounded on the near side by the law of gravity and on the far side by obsolescence. He strives for adequacy, but not for permanence or perfection. His one legitimate aim is to produce a satisfactorily functioning entity that will not fall apart before it is ready to be torn down.

The best engineering structure in the world is nothing but some designer's makeshift. Along with the disillusionments about Santa Claus and perpetual motion, the engineer, early in his professional existence, is forced to discard Utopian dreams of perfection and to be satisfied if his efforts produce but a crude approximation to the balanced design exemplified and immortalized by Holmes in *The One Hoss Shay*.

To the extent the engineer overdesigns his mechanism he is magnifying the cost unjustifiably, which is not good engineering. To the extent that he fails to foresee and allow adequately for adverse factors, he jeopardizes both the usefulness and the safety of his mechanism, and likewise, his own professional standing. By superimposing certain mathematical techniques and his own judgment and constructive imagination on accepted rules of good practice—the accumulated experience of his professional predecessors—the engineer achieves a working balance between too good and too poor.

The age required to outlive usefulness is sometimes brief and always difficult to predict. Utilitarian structures, those normally in the engineer's bailiwick, may be built and outmoded within half a lifetime. Our generation has seen elevated railways, trolley cars and skyscrapers scrapped while structurally in their prime—sacrifices on the altar of anything from economic necessity to a whim. Today's ceremoniously-laid cornerstone is rubble for tomorrow's bulldozer.

Even within its dubious span of useful life, a structure will remain ever sensitive to its environment; to loads, rust, decay and fatigue. When 99 years and 364 days old, the One Hoss Shay was going strong. One day later it went, "all at once and nothing first, just as bubbles do when they burst."

> Bricks will break and rocks will fall,
> Paint will peel and concrete spall,
> Wood will rot and steel will rust,
> Ashes to ashes and dust to dust.
> —Author unknown
> quoted by R. B. Young, M. ASCE
> Proceedings of ACI, Vol. 44 (1948), p. 740

Engineering, although presumably the most definite and tangible of the professions, fails to achieve the high degree of exactness with which, in the popular mind (and in the engineering mind) it is often invested. Regardless of what he doesn't know, the engineer must proceed and produce. He cannot stand and shiver at the water line of his uncertainties. From a maze of assumptions and approximations, including estimates of useful life, the engineer must, with the aid of a slide rule, a factor of safety and a hammer, produce something that will be safely and economically serviceable for the time required. No longer is an engineering operation pronounced a success if the patient dies from bankruptcy or some other non-engineering ailment.

Probably the good record of engineering performance on the whole (notwithstanding the Quebec and Tacoma Narrows bridges and St. Francis and Fort Peck dams) is due more to excess caution and fortuitous circumstance than to engineering foresight. In other words, the engineer has profited by placing his major emphasis on what he fears he may not know or may have overlooked. He has habitually proceeded with caution rather than with ill-advised assurance. Factors of safety have doubtless contributed more to the longevity of engineering works and made or saved more professional reputations than have specific visualization, accurate figures and freedom from flaws—indispensable though these things are in the engineers' world.

As a class, engineers are understandably modest with respect to their achievements, for no engineer has attained professional maturity or breadth of experience without frequent reminders that throughout his whole professional existence he skates on thin ice over water of unknown depth. Every now and then he gets a surprise ducking and it is usually sheer luck if the pond happens to be so shallow that only his self-assurance gets wet. The ducking may be the result of some inexcusable oversight on his part, or another's mistake, or of an unusual or novel situation which he could scarcely have been expected to foresee.

The extensive adverse publicity which attends a major engineering failure invariably results in rapid assimilation of the lessons to be learned and in their early incorporation into the designers' and builders' backlog of essential knowledge in the field. Thus many sensational failures, properly designated as "acts of God" when they first occurred, would, if they happened now, be attributed to criminal negligence or inexcusable ignorance of man.

Any designer's manual is packed with requirements and provisions based on early sad experience rather than on abstract foresight. The use of cutoff walls in canal structures; the necessity for drainage under a dam; provision for adequate spillways over, through, or around dams;

The engineering of today rests on a coral reef; the sturdy remnants of yesterday's bugs

in engineering: the bugs

to underlying philosophies and practical aspects of current engineering practice

the need for fireproofing as incombustible a material as structural steel; the inclusion of traps and vents in plumbing layouts, are but a few examples. *The engineering of today does indeed rest upon the sturdy remnant of yesterday's bugs.*

It is the aim of every engineer to plan his work so thoroughly that there will be no bugs—no unwelcome intrusions of the unforeseen and unexpected. The nearness of an engineer's approach to this unattainable ideal is perhaps the best measure of his stature as an engineer. Second only to the engineer's ability to practice preventive medicine is the effectiveness with which he applies corrective surgery.

Some of the most fascinating chapters in the life and memory of any engineer are those dealing with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor. The occurrence of the unexpected in engineering resembles the plot of a detective story, mysterious only until explained. If told with comparable skill, many engineering mysteries would rival detective stories in interest and dramatic appeal.

Foresight, vigilance and ingenuity are the bodyguards of structures and of professional reputations. Except for "acts of God," these qualities can usually be relied upon to outwit and out-maneuver the violent law of gravity until the gentle anesthesia of obsolescence induces the long sleep of painless and honorable oblivion. After all, whether the end be early or late, violent or painless, honorable or otherwise, each day of service brings every engineering mechanism one day closer to its ultimate goal—the scrap heap.

Addendum

When the series was submitted to the editor, the bugs were classified under about a dozen headings such as faulty design, major ailments, job slip-ups, and fallacies of concept.

Three sources were drawn upon: personal experiences by the author, accumulated during his younger days as a practicing engineer and subsequently as an occasional consultant; known experiences of fellow engineers; and more-or-less stock incidents.

This article is directed primarily toward college upper classmen and engineers in the younger bracket of experience; although the author hopes that other engineers who read the article will not deem the time altogether wasted.

In the contemplation of these incidents and situations (especially if a serious effort is made to formulate an explanation before consulting the appended discussion) it is possible for a young man to gain a better picture of some interesting aspects of engineering practice; to broaden himself and, by proxy, to sharpen his engineering wits. He needs to recognize and realize at the outset, however, that these incidents are purely illustrative. A bug rarely bites twice in in the same spot.

The incidents selected were intended to be neither the best nor the most entertaining that might have been chosen. One could write a more formal and doubtless, a more interesting paper on unanticipated major engineering developments such as the Ead's Bridge closure, the foundation problem that was met successfully at Coulee Dam, the great slides at Panama, and at the Ft. Peck and Lafayette Dams, problems surmounted successfully but expensively in the Moffat and other tunnels, the Golden Gate Bridge abutment difficulties, not to mention some of the major disasters. These were already well-covered and the recital was purposely restricted almost exclusively to relatively minor incidents representative of those an ordinary engineer might encounter during his own routine practice.

To some, they will seem unwarrantably simple and obvious. Almost any engineer can probably counter with a better. Not the least reason for writing this series was the hope that some of the engineers who have hidden away in their own practice and contacts some really good (but true) anecdotes, may be moved to disclose them for the benefit of the rising engineering generation and the entertainment of the current one.

To get the project under way the author concurred in the publication of one bug each in the February and March issues under the caption, "How would you do it?" According to the present plan, the foregoing article and this addendum constitute the lead-off for the "How would you do it?" series started last February.

In view of the inexhaustible supply of suitable material available from fellow engineers, and with the author's initial list as pump primer and backlog, it appears that if the innovation is short lived it will be through lack of reader interest rather than lack of copy.

If the idea takes hold it should constitute a minor step toward the reintroduction of color into what was once the most colorful of the professions but which has increasingly assumed an all-technical hue. The day is past when civil engineering is synonymous with high-top boots and a transit in cowboy country, a symbol for frontier-type adventure, where the hero was a hard-muscled close-mouthed harbinger of mysterious big developments in the offing. The day will never arrive, however, when the practice of real engineering fails to be a method of overcoming successive obstacles, not only through the application of technical skills to the predictable but also through the exercise of horse sense, sound logic, and mental agility to meet the unforeseen.

The memory of every successful engineer is replete with incidents which embodied elements of mystery and adventure—engineering romance. The best stories are yet to be written—perhaps yours is one of them.

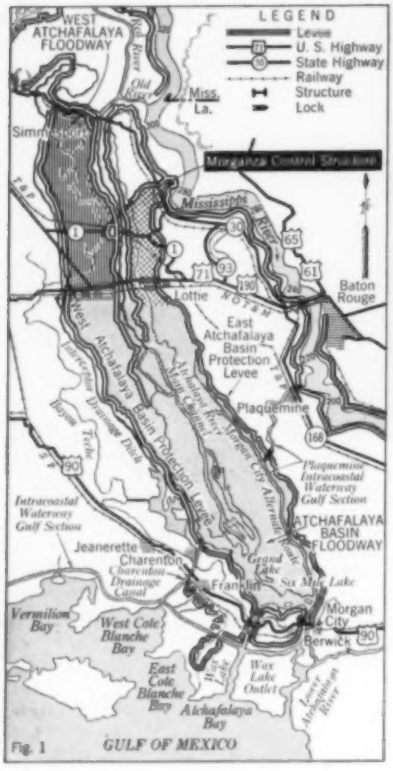


Fig. 1

Morganza Floodway, designed to pass flood waters from Mississippi River into Atchafalaya Basin, will divert 600,000 cfs from leveed lower channel of river. See Fig. 1 left. Construction of control structure is expected to be complete in 1953. Site of structure is indicated on aerial view.

Morganza Floodway to steal 600,000 cfs of M

To keep the flood waters of the Mississippi from the frequently devastated delta region of Louisiana, engineers are now building another concrete colossus, the Morganza Floodway. This project, with its 4,000-ft controlled opening and 19,000 lin ft of earth-fill embankment, will divert 600,000 cfs at 55-ft flood stage into the Atchafalaya Basin.

The Mississippi, the great trough of the North American continent, carries its constantly accumulating burden without relief, except that provided by overbank floodways, until it reaches a point at the southwest corner of the State of Mississippi, 73 river miles above Baton Rouge. There it releases, for the first time, part of its burden through a channel not its own. This natural supplementary outlet, which runs roughly west to discharge into the Atchafalaya River, is called Old River (Fig. 1). Below Old River the Mississippi continues to the Gulf with one artificial outlet at Bonnet Carre, 33 miles above New Orleans. The Atchafalaya River, which collects water from the Red and Old rivers, flows into the Gulf by way of Morgan City and the Wax Lake Outlet.

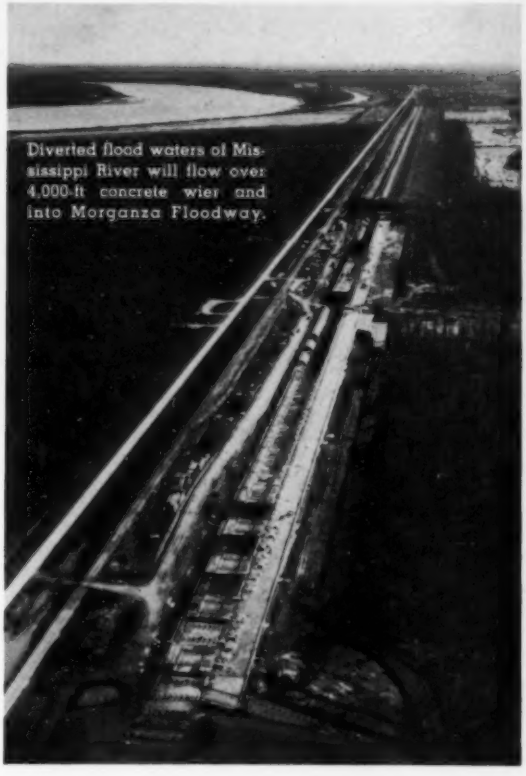
The project flood from the Mississippi, when it reaches Old River is 2,800,000 cfs. Old River has a capacity of 600,000 cfs, which is insufficient relief to prevent dangerous flood heights at New Orleans even with the help of the Bonnet Carre Spillway. The Morganza Floodway has been designed to take an additional 600,000 cfs from the Mississippi below Old River and release it into the Atchafalaya Basin, 57 miles below the junction of the Old and Atchafalaya rivers.

Considerations in selecting the site for the intake or upper end of the floodway were: to place it a minimum distance below Old River, to provide favorable entrance conditions, to avoid settled communities and improved lands, and to secure as favorable foundation conditions as possible. The site selected is approximately 23 miles below Old River and immediately above the town of Morganza.

Utilities crossing the site of the floodway are Louisiana State Highway 70 and a branch line of the Texas & Pacific Railway, both crossing near the entrance; the main line of the Texas & Pacific Railway, crossing at an angle about ten miles below the entrance; and Highway 190 and the main line of the New Orleans, Texas & Mexico Railway, both crossing about 19 miles below the entrance. Highway 70 and the Texas & Pacific branch line will be carried across the floodway on the control structure. Trestles have been built for the other utilities.

Foundation conditions at the site of the control structure, while not particularly good from the standpoint of an engineer practicing outside the alluvial basin, are as good as can be found in most parts of southern Louisiana. From 80 to 90 ft of clay, predominantly soft and fat, overlies a thick bed of fine and medium sand. The contact between the sand and the clay is transitional and irregular. A few clay lenses are found near the top of the sand stratum.

Compression and tension tests were conducted on piles seated in the deep sand. The compression test loads were 400 tons. Piles to be tested for tension were first subjected to compressive loads of 85 tons and then tested in tension to failure, or a maximum of 150 tons. From the results of the tests, precast concrete piles were chosen with design loads of 90 tons in compression and 25 tons in tension. At locations where clay



Diverted flood waters of Mississippi River will flow over 4,000-ft concrete wier and into Morganza Floodway.

D. L. WHITE, M. ASCE, Chief, Construction Division

New Orleans District, Corps of Engineers, New Orleans, La.

Mississippi's thunder

lenses existed in the upper part of the sand stratum, it was believed that jetting would be necessary in order to drive the piles.

After the foundation had been investigated, the designers considered the volume of water to be passed by the structure, the utilities to be carried, the facility of controls, and the protection against erosion. They arrived at a plan for a control structure 3,900 ft long, consisting of a concrete weir divided into 125 bays each having a clear span of 28.25 ft. The piers between each bay support the highway, railroad and tracks for the gantry cranes used to manipulate the double-leaf vertical slide gates. They would also act as guides for the gates. A stilling basin was provided below the weir. Riprap and derrick stone were placed downstream from the stilling basin and on the upstream side of the weir. Each bay of the weir was to be supported on 27 batter piles—11 battered upstream and 16 downstream. The batter was fixed at 2 vertical to 1 horizontal. The abutment was designed to rest on vertical piles.

The total cost of the structure and adjacent embankments was expected to be in excess of $20,000,000. The types of work required in the structure vary, and therefore, the project has been broken up into several contracts to encourage small bidders, to stimulate bidding and to keep subcontracting to a minimum.

The embankment contract was scheduled first to give time for settlement to occur before the railroad and highway were relocated. The placing of the fill and relocation of the highway and railroad were divided into six phases.

The contract for construction of Phase 1 was let on April 5, 1949, to Grenada Dam Constructors, Inc., of Grenada, Miss., at unit prices which total approximately $1,555,000. There are 3,998,000 cu yd of fill in this phase. Construction progressed without notable difficulties or delays except during the winter season of 1950–1951. Work was completed October 16, 1951.

Work under Phase 2 was let to J. B. Talley of St. Martinville, La., on June 11, 1951. No difficulties were encountered and this part of the embankment was completed on November 13, 1951. Work on the other phases will not start until the structure is sufficiently completed so that the railroad can begin laying ballast and track on top of the piers. This is expected to be late in the summer of 1952.

A contract was awarded for driving the piling on May 18, 1950. The Raymond Concrete Pile Co. submitted the low bid of $2,395,570. The principal items in this contract were for furnishing 27,300 lin ft of Type A concrete piling at $5.70 per ft; 330,000 lin ft of Type B piling at $5.00 per ft; and driving both types of piling at $1.05 and $0.97 respectively. Type A piles were designed with a $2\frac{1}{2}$-in. jet hole through the center, while Type B were ordinary concrete piles. Both types have an octagonal cross section 20 in. across the flats. Piles over 100 ft long are square (Fig. 2). Approximately 95 percent of the piles were driven on a batter of 2 vertical to 1 horizontal.

The contractor began work at the site on June 1, 1950, by constructing car storage tracks adjacent to the railroad main line; a pile casting yard near the transverse center line and west of the structure; and a lead track through the structure (where a temporary gap was to be left) to connect the storage tracks with the casting yard. The casting yard was 1,000 ft long and traversed by a gan-

Pile casting yard provided space for 194 piles before movement, plus an additional 205 piles, stacked two high. Yard was 1,000 ft long. Piles were delivered to drivers on two flatcars.

Gantry crane, spanning 135, bundles precast concrete piles in casting yard. Crane is equipped with tongs to lift piles at four points.

try crane running on rails 135 ft apart. The yard provided space for 194 piles before movement and for an additional 205 piles, piled two high, in storage. The gantry was fitted with lifting tongs to support the piles at four points. Piles were delivered to the drivers on two flatcars. The pile plan is shown in Fig. 3.

An interesting feature of the pile casting was the Thompson-Gibb, Model F14, 100 KVA, Flash Welder used in butt-welding the longitudinal reinforcing bars for the piles. This machine is of the hand-pushup and hand-clamp type, measuring 60 in. long by 55 in. wide by 52 in. high, and having a net weight of 3,085 lb. A special auxiliary power plant was constructed near the site of the welding operations, with a 75-hp electric motor pulling the generator which furnished electricity for the welding machine.

The flash welder was mounted on railroad trucks and could be moved by hand on a track the full width of the steel fabricating yard. This track was constructed under the steel racks, which were approximately 5 ft above the ground level, and parallel to the bars to be welded. A jack was used to raise the machine to the desired height. This jack operates between the dolly and the base of the machine, leaving the wheels in contact with the rails.

The steel reinforcing bars were placed on the steel racks by a steam gantry crane and rolled by hand to the location of the welder. The specifications required the staggering of splices in each pile, which necessitated the moving of the welder along the track to the location of the splices to be made. The welder was moved to the desired location, jacked up, and as many welds made as required. A series of dead rollers directly over the track facilitated the moving of the bars into position in the welder.

The ends of the bars to be welded were brushed with a wire brush, cleaned, fastened in the clamps, and then brought together under the required heat and pressure to form a butt weld. The welded steel bar was removed from the clamps and rolled down to the fabricating table, where it was tied into a reinforcing cage for a precast concrete pile.

Two drivers were used. They were of the Universal type with 136-ft leads capable of being set for vertical and in-and-out batter driving. The driver engines had seven hoisting drums and one swinger. The hammer was a modified Vulcan No. O delivering 32,500 ft-lb with a 10,000-lb ram. A trench the width of the structure had been dug to the foundation elevation over the entire length of the job. The drivers spanned this trench area, skidding on cribbing on each side of the trench.

Soon after the contract was awarded, it was decided that jetting of the piles should be avoided if at all possible, since jetting would decrease the skin friction and leave pockets of loose sand near the points. The specifications limited driving with a 32,500-ft-lb hammer to 316 blows per lin ft of pile. The contractor believed that the piles could be driven through the sand above the clay lenses without jetting if he were allowed to exceed the maximum blows per foot allowed by the specifications. This plan was adopted, discretion being granted the project engineer to decide the resistance at which driving should be stopped. All piles were driven to the planned penetration without serious spalling.

Before the contract was let it was thought that some difficulty might be encountered in driving piles 100 ft long on a 2 on 1 batter. Possibly because of the contractor's efficient planning and organization, difficulties were kept to a minimum and progress was better than generally expected. An average of 7 piles were driven in each 8-hour working day by each driver. The specifications provided that any pile deviating from its exact position by more than 6 in. must be replaced. It was necessary to replace only one pile. The contract period ended on November 9, 1951. The last pile was driven on August 9, 1951.

At one time it was feared that the battered piles might be deflected by the hard driving in the sand above the clay lenses, and that the piles might be breaking or at least bending dangerously. To determine the bend, if any, a 5-in. pipe was encased in three of the piles. After these piles were driven, a cylinder containing an automatic camera and a plumbob was lowered through the pipes by the Eastman Oil Well Survey Co. The Eastman Co.'s report based on the resulting pictures of the plumbob hanging over a graduated target showed that, for the three piles tested, the maximum deviation of the pile tip from its planned position was 1.9 ft. This was not considered serious.

Experience in this area showed that excessive settlement will occur when an abutment is backfilled if the soil underlying the abutment and adja-

Longitudinal reinforcing is butt welded. Splices in each pile are staggered. Octagonal metal forms collapse easily after pile has set.

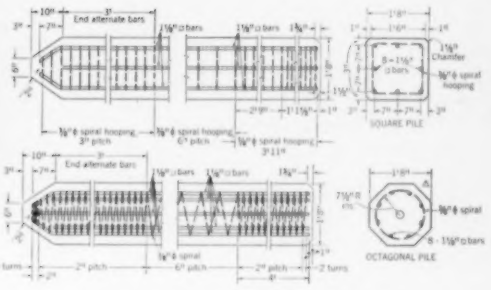


FIG. 2. Specifications require that piles longer than 100 ft be square. For shorter lengths, either square or octagonal shape was permitted. Contractor has chosen to use octagonal shape.

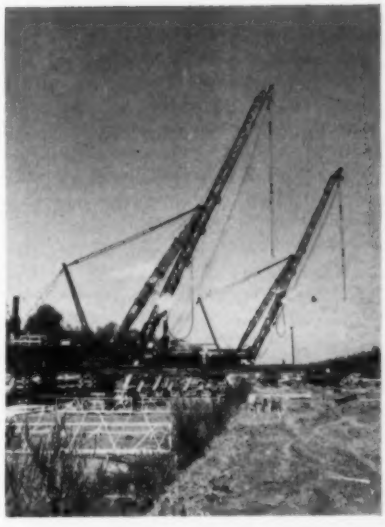
cent areas is not precompacted. The embankment was extended, therefore, at full height approximately 300 ft beyond the abutments into the area in which piles were to be driven. The Raymond Concrete Pile Co. left the earth load on the abutment areas until it threatened to interfere with driving progress. Elevations taken on the settlement plates after the loads had been removed showed that the maximum settlement secured was approximately 2.5 ft. A settlement of about 5 ft is expected to occur beneath the main embankment.

A contract for construction of the superstructure was awarded on August 14, 1950, to Farnsworth & Chamber Co. of Houston, Tex. The total bid for this item of the work was $5,269,069.00.

This contract included construction of the base slab, weir, stilling basin, piers and bridges, which totaled about 122,000 cu yd of concrete and 7,000 tons of reinforcing steel. The contract period was 800 days. To accomplish the work on this item, the contractor used 5 cranes, two 34-E Koehring dual-drum pavers, 1 bulldozer, 1 motor patrol, and auxiliary equipment.

Concrete aggregates were secured from Dunham-Stevens Gravel Co., which operates a pit at Pollock near Alexandria, La., and Holloway Sand & Gravel Co. of Baton Rouge, La. The cement, which was Type II, was furnished by the Ideal Cement Co. from its Mobile and Baton Rouge plants.

The superstructure contractor was required to start work near the middle of the structure in order to avoid



Special rigs drive batter piles.

Construction of superstructure began near middle of structure to avoid interference with pile-driving operations. Working areas were turned over to contractor on superstructure in 600-ft strips after pile driving had been completed.

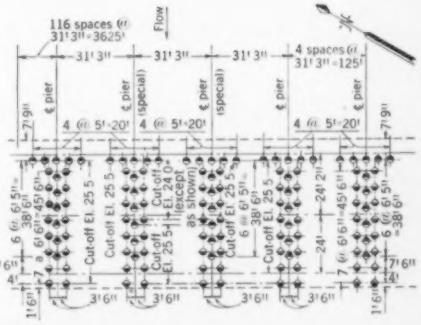


FIG. 3. Pile plan calls for driving in groups for piers. There are 125 piers, each containing 27 piles. Outer rows of piles are battered 2 on 1 upstream, while five piles on upstream end and those in center row are battered downstream.

interference with the pile driving operations. The specifications required that working areas be turned over to the superstructure contractor in 600-ft strips after the piling contractor had completed driving and cleaning up in each area. Actually, the superstructure contractor was not given the first area until a much greater distance was available as it was felt that the construction of the base slabs would overrun the drivers unless a greater lag in time was allowed.

The superstructure contractor had unlimited space for his operations in a longitudinal direction but was restricted in width. There were approximately 40 ft between the ends of the spur track ties and the top edge of the excavation available for working and storage space. In this narrow space he set up his concrete batch hopper, stockpiled the aggregates and steel, maintained an access road, and operated the paving mixers. Cranes standing on top of the bank picked up the buckets and deposited the concrete in the monoliths.

Blaw-Knox steel forms are being used in the concrete pouring operations of the weirs, piers and bridge deck for the highway, railroad and gantry. Five sets of forms for each type of bridge deck have been provided. Travelers for handling the deck forms are also provided by the Blaw-Knox Co. A complete unit contains an adjustable traveler for handling steel forms and a transfer carriage for handling the traveler, each mounted on dollies which run on rails. The transfer carriage operates parallel to the longitudinal center line of the structure, on the stilling basin slab. The adjustable traveler moves transversely to the center line of the structure and contains sufficient clearance for the transfer carriage and can be placed in position directly over it. Four stationary 20-ton jacks located on the transfer carriage are then used to raise the adjustable traveler, after which both are moved longitudinally to a position opposite the next deck pour. By letting off on the jacks, the adjustable traveler is lowered onto its previously prepared track and moved into position for setting the deck form.

The adjustable carriage contains two sets of hydraulic jacks, each set consisting of four 20-ton jacks with 24-in. pistons. By means of these jacks the steel forms are raised into position for the concrete pouring operations. When stripping, the forms are lowered by the jacks until there is sufficient clearance to pass them under the bridge deck beams.

Flood waters will flow over 3,900-ft concrete weir divided into 124 bays. Stilling basin is provided below weir.

The bridge-deck forms are supported near each end by columns resting on pipe jacks. After the forms have been spotted in approximate location for the pour, the adjustable traveler is moved and utilized in setting other forms.

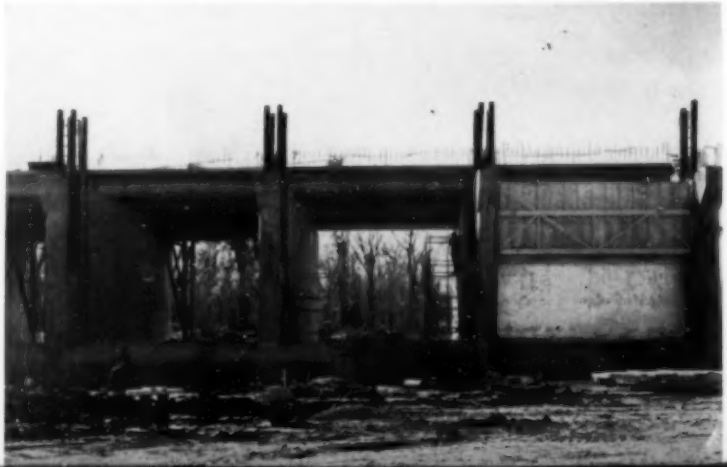
During the first months, concrete aggregate was not received in sufficient quantity to maintain a satisfactory schedule. The demand for railroad cars was greater than the supply, and difficulty was experienced by the suppliers in meeting the government specifications, which differed from those in local use. These problems have now been solved and aggregate is arriving satisfactorily.

The national emergency restricted steel shipments, but the contractor was never obliged to close down although he did on occasion revise his schedule of pouring monoliths to take advantage of the steel he had. As of March 1, 1952, 100 percent of the reinforcing steel had been received, with the result that no serious delays from this factor were experienced.

As of March 1, an average of 6,624 cu yd of concrete a month has been placed. Unless unforeseen obstacles slow down the work, the structure will be operable for the high-water season in the spring of 1953.

Coordination of working space between the pile driving and superstructure contractors has not been as difficult as expected. Allowing sufficient lead time to the piling contractor eased the situation materially. Separation of working yards on opposite sides of the structure has also minimized a conflict of interests.

Concrete piers, 31 ft 3 in. on centers, divide control structure into 124 bays. Piers also support relocated highway and railway. Track for gate-operating gantry crane also is supported on piers.



Pile driver spans foundation trench and is skidded along on cribbing on each side. Vulcan No. 0 hammer was used with 10,000 ram, delivering 32,000 ft-lb.

A contract was awarded on May 25, 1951, for furnishing and placing the protection stone on the downstream and upstream sides of the structure. John Yakimo of Dallas, Tex., was low with a bid of $907,875. The specifications stated that this contractor would not be required to start work at the site before November 9, 1951.

As of January 1, 1952, clearing had been completed and as of March 1 the excavation for the riprap was 55 percent complete. It is expected that placement of filter gravel will be started within the next month and shipments of protection stone will be received soon thereafter. No delay under this contract is anticipated.

A contract was awarded for furnishing the steel gates on December 11, 1950. Avondale Marine Ways of New Orleans submitted the low bid of $937,260. This contract consisted of furnishing 127 upper and 127 lower gates to the Farnsworth & Chambers Co. before April 1952. The upper gates weigh 8 tons and the lower gates 12 tons each. Gate leaves consist of a steel skin plate supported on two horizontal girders by a series of vertical ribs. To reduce friction, each gate will be equipped with wheels on which it will roll in channels set in the piers. Molded rubber seals will be used to prevent excessive leakage.

As of January 1, 1952, all the steel had been received and as of March 1 98 percent of the gates had been fabricated. Two gates were delivered to the site of the work for a test installation. It is anticipated that all the gates will be delivered before it is possible to complete their installation.

On January 23, 1951, a contract was awarded for two gantry cranes to operate the gates (Fig. 4). The Pacific Coast Engineering Co. of Alameda, Calif., submitted the low bid of $243,340. The cranes will be self-powered with gasoline-electric generating units to supply power for the crane motors. In addition to the main hoist, which will have a capacity of 25 tons, each crane will be equipped with a jib crane on one leg, with a 1-cu yd clamshell bucket to handle logs, drift and other debris that may accumulate near the structure. Work has started on the assembly of parts and fabrication of steel at Alameda, Calif., but because of difficulties in obtaining some of the special items, it is probable that both cranes will not be delivered to Morganza until December 1952.

At this moment there appear to be no probable construction difficulties to prevent completion of the structure as planned, except for procurement of materials. Every effort will be made to have the structure ready for operation for the high-water season of 1953.

The Morganza control structure was designed and is being built by the Corps of Engineers. Lt. Gen. Lewis A. Pick, M. ASCE, is the Chief of Engineers and has over-all supervision of the work. Brig. Gen. Peter A. Feringa, M. ASCE, is President of the Mississippi River Commission, directing the design and construction. Col. Charles G. Holle is the District Engineer at New Orleans and the Contracting Officer for construction. Martin G. Chitty is the District Engineer's representative in the field.

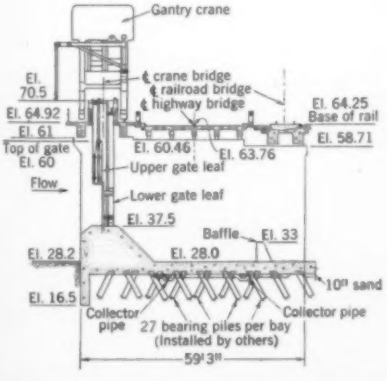


FIG. 4. Typical section through control structure shows relative position of highway, railroad, and gantry tracks. Piles supporting foundation bear on sand stratum, which in some places is 118 ft deep.

Gantry-operated double-leaf steel gates will control flow of water through control structure. Molded rubber gaskets increase water tightness of gates.

CARL N. ZANGAR, A. M. ASCE, Head, Photoelastic Group

R. J. HAEFELI, J. M. ASCE, Engineer, U. S. Bureau Reclamation, Denver, Colo.

Electric analog indicates effect of

A problem that has long been of interest to the designers of dams is the computation of hydrodynamic pressure due to horizontal earthquake shock. Recently the Photoelastic Unit of the Bureau of Reclamation in Denver, Colo., investigated a new approach to this problem by using an electric analog to determine the magnitude and distribution of the water-pressure changes due to a horizontal earthquake on a dam with a face of any shape. The designer needs only to select a reasonable value for the earthquake intensity and the proper experimentally determined pressure coefficient to arrive at the water pressures. With the pressures known, the horizontal and vertical shears and the moments, and their effect on stability and stress, can be computed by statical methods.

The method presented here requires adoption of the following assumptions: water is incompressible; the dam is a rigid wall which moves as a unit with the foundation; the displacements of the water body are small; and the flow of water is two-dimensional.

The differential equation of the pressure may be expressed as

$$\frac{\partial^2 P}{\partial x^2} + \frac{\partial^2 P}{\partial y^2} = \frac{1}{c^2} \cdot \frac{\partial^2 P}{\partial t^2}$$

in which

P = change in pressure at any point having the rectangular coordinates x and y
c = velocity of sound in water
t = time

If water is considered incompressible, the bulk modulus, and hence c, become infinite. Then the pressure equation becomes

$$\frac{\partial^2 P}{\partial x^2} + \frac{\partial^2 P}{\partial y^2} = 0$$

This is the LaPlace equation which also governs the steady state of flow of electricity. Therefore the electric analogy tray apparatus can be used to obtain flow nets. The flow net is an orthogonal system which consists of streamlines and equipotential lines. If these lines are equally spaced to form a system of curvilinear squares, then the maximum pressure change at a point may be expressed by the equation

$$dp = \frac{1}{n}\, \alpha c w h$$

and the pressure change at any point by

$$P = C \alpha w h$$

where

C = experimentally determined, dimensionless coefficient giving distribution and magnitude of pressure
α = earthquake intensity
w = unit weight of water
h = total reservoir depth

The application of the theory requires the construction of an electric analogy tray model as shown in Fig. 1. Sheet plastic was used for the tank and a plastic boundary wound with nichrome wire was used to represent

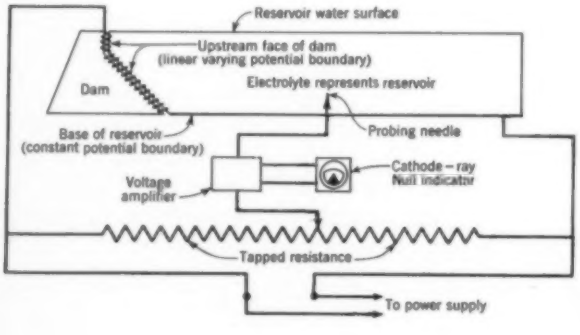


FIG. 1. DIAGRAM shows layout of electric analogy tray model by which pressure on face of dam due to horizontal earthquake shock is simulated.

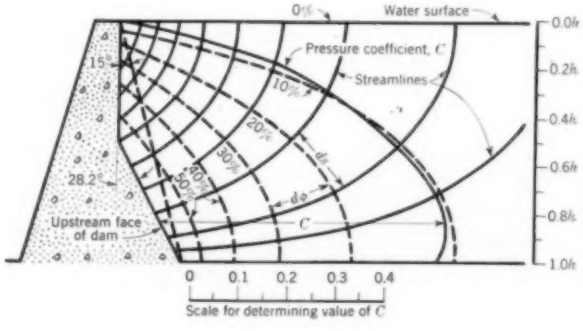


FIG. 2. IN TYPICAL FLOW NET, equipotential lines are drawn perpendicular to streamlines. Pressure coefficient, C, is determined from point of intersection of equipotential line with face of dam.

horizontal earthquake shock on dams

the face of the dam. The bottom of the reservoir was made of a copper strip to provide a constant potential. The length of the tank was kept at least three times the width to simulate an infinitely long reservoir. The tray was filled with an electrolyte and the streamlines were surveyed by means of the Wheatstone bridge of the electric analogy tray. Equipotential lines were drawn perpendicular to the streamlines to form an orthogonal system. The pressure coefficient, C, was then determined directly from the nominal value of the equipotential line intersecting the dam. See Fig. 2.

Six constant slopes and 15 combination slopes of faces were investigated. Pressure coefficients for constant sloping faces are shown in Fig. 3.

A comparison between the electric analogy method and two other methods is given in Fig. 4. The method of Ven Te Chow was explained in his article, "Hydrodynamic Pressure Due to Horizontal Earthquake Shock Computed by Curves" (CIVIL ENGINEERING for September 1951, p. 52). See also the writers' discussion of Mr. Chow's article (CIVIL ENGINEERING for January, p. 137). The method of Messrs. Hinds, Creager, and Justin is given in their book, *Engineering for Dams*, Vol. 2. For comparison, a ratio of maximum pressure on sloping faces to maximum pressure on vertical faces is used.

Results of the electric analogy study show that the electric analogy tray offers an easy method for obtaining the increase in water pressure on dams due to horizontal earthquake shock. Specifically the study has shown that:

1. The increase in pressure on dams with sloping faces is less than on dams with vertical faces.
2. The flatter the slope, the smaller the increase in pressure.
3. Except for a vertical face, the maximum pressure coefficient occurs at some distance above the base of the dam (see Fig. 3).
4. The distribution of pressure on any constant slope can be represented approximately by a curve resembling a parabola.
5. The hydrodynamic pressure distribution on the face of a dam due to horizontal earthquake may be expressed by the equation,

$$P = Cawh$$

in which the maximum value of the pressure coefficient C was found to occur on vertical-face dams, where

$$C = 0.735.$$

6. Dams having upstream faces that are vertical for half or more of the total depth of reservoir will have hydrodynamic pressures practically equal to those on dams having vertical faces for the full depth (assuming dams of equal height subjected to the same earthquake intensity).
7. Finally, the effect of compressibility introduces only small errors which can be neglected when compared to the total water force applied to the dam.

Thus the designer can readily determine the effect of hydrodynamic pressures on the face of any structure by selecting the proper values for the pressure coefficient, C, and the earthquake intensity α. At present, the choice of intensity must be based on experience and available seismic records. Earthquake spectra need to be determined for structures having a wide range of fundamental periods, including the effects of damping. An excellent discussion of the selection of a reasonable intensity for a horizontal earthquake is Separate No. 66 (PROCEEDINGS, ASCE, April 1951), "Lateral Forces of Earthquakes and Wind," by a Joint Committee of the San Francisco, Calif., Section and the Structural Engineers Association of Northern California.

The electric analogy tray study was developed and performed by the writers at the Chief Engineer's office, U.S. Bureau of Reclamation, Denver, Colo.

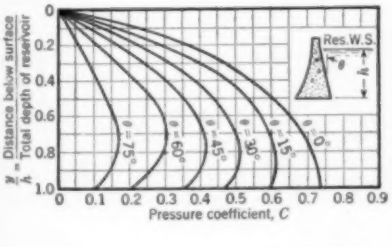


FIG. 3. VALUES of pressure coefficients are shown in curves for upstream faces of dams of various uniform slopes.

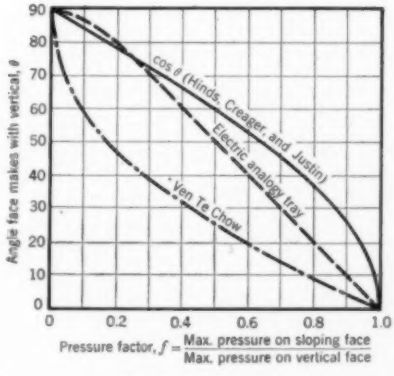

Angle face makes with vertical, θ
cos θ (Hinds, Creager, and Justin)
Electric analogy tray
Ven Te Chow
Pressure factor, f = Max. pressure on sloping face / Max. pressure on vertical face

FIG. 4. THREE METHODS for determining hydrodynamic pressure on upstream face of dam due to horizontal earthquake shock.

SOCIETY NEWS

New Orleans Is Host to Unusual Spring Convention of Society

New Orleans welcomed more than 1,200 engineers and their families to the ASCE Spring Convention with traditional Southern hospitality and a unique tribute to the accomplishments of the profession. In an official proclamation extolling the civil engineer "as a bulwark in the struggle for survival and in the search for a higher and better standard of living" and honoring the centennial of ASCE, Mayor de Lesseps S. Morrison declared the period March 2 through 7, "Civil Engineering Week in New Orleans."

In welcoming the visitors to New Orleans at the opening ceremonies on Wednesday morning, Frank K. Macdonald, president of the Louisiana Section, and Mayor Morrison referred to the city's improvement program, calling attention to its status as the nation's second port, its great union terminal and grade elimination project, its new hotel and apartment buildings, and its ambitious city plan for years to come. In response ASCE President Carlton S. Proctor reviewed the geologic conditions that have made the development of New Orleans an engineering triumph, and praised the city's determination and vision in undertaking and pushing an extensive improvement program.

During Convention week Colonel Proctor also addressed a luncheon meeting of the New Orleans Rotary Club on the growing menace of statism. He urged engineers to become active in community affairs as part of the general fight to save the nation from a strong centralized state. In an address before the Wednesday membership luncheon on "Political Variables in Engineering Administration," Robert W. Elsasser, New Orleans management analyst, told the group, "It is probable that you don't know your own power. The use of engineering practice techniques of fact-finding and analysis in the areas of political force and group standards will bring surprising personal rewards."

Rose Barry receives engrossed testimonial of Board of Direction from President Proctor during New Orleans Convention upon her retirement as head of ASCE membership department after 36 years on Society staff. In making presentation, Mr. Proctor said that Miss Barry processed his application for membership 22 years ago as well as those of other Board members. Scene at opening session (upper left photo) shows Executive Secretary William N. Carey; Frank W. Macdonald, New Orleans Section president; and Mayor de Lesseps Morrison.

President Proctor opens new type of Faculty Advisers' Conference at New Orleans. Shown here, left to right, are Dean Lee H. Johnson, chairman of student activities for New Orleans Convention; Mr. Proctor; C. D. Williams, conference chairman; and ASCE Director G. B. Earnest, Contact Member for Student Chapter Committee.

Many local engineering projects and problems were discussed in seventeen Technical Division sessions, under the chairmanship of Bernhard M. Dornblatt. These included the city's multi-million-dollar civic improvement program; the development of the Port of Lake Charles; the many aspects of offshore petroleum drilling; Mississippi River pipeline crossings; the New Orleans traffic problem; mapping of the city and state; Mississippi River flood control; and the salt-water threat to Louisiana rice fields involving the ever-present problem of drainage. Inspection trips to the union terminal and grade separation project and the special pumping plants (one of them the largest in the world) necessitated by the city's location below water level were among several arranged to supplement discussion of local projects. Several of the technical papers are published in this issue. Others have been made available in special preprint form (see pages 63 and 85).

Speedup of the city's defense planning was urged in a special Civil Defense Session under sponsorship of the ASCE Civil Defense Liaison and the Louisiana Section. Two Civil Defense Administration officials from Washington discussed

engineering aspects of the CD shelter program and design of protective structures and shelters. Another session featured a motion picture and talk on the atomic bomb tests at Eniwetok, presented by D. Lee Narver, Los Angeles consultant.

A new type of Faculty Advisers' Conference, was pioneered by Dean Lee Johnson of Tulane University, chairman of the student activities' program, and C. D. Williams, member of the ASCE Committee on Student Chapters. Constructive group discussion was touched off by a number of papers prepared by experienced faculty members. Other special events of the Convention week included an inaugural meeting of the newly formed ASCE Committee to study Technical Structure (page 58, this issue), and an all-day Student Chapter Conference that attracted the gratifying attendance of 250.

The women attending the Convention found that their local hostesses, under the chairmanship of Mrs. Frank W. Macdonald, had set up a varied program of luncheons, dances, boat trips, a tour of the French Quarter, and a fashion show, and provided shopping and sightseeing information centers.

The hospitable spirit of the city, whether demonstrated by Convention officials or the man on the street when he spotted a Convention badge, was so marked as to be the subject of general conversation among Convention visitors and to make the New Orleans Convention one long to be remembered. David W. Godat was general chairman, and Lee H. Johnson vice-chairman.

First meeting of Committee to Study Technical Structure is pictured in top view. Shown, left to right, are Philip C. Rutledge, Frank A. Marston, Jewell M. Garrelts, chairman, D. V. Terrell, and George R. Schneider. In photo taken at one of three Authors' Breakfasts (lower view) are Mr. Schneider, presiding official at Hydraulics Division session; Ross White, who presided at Construction Division session; B. M. Dornblatt, chairman of technical program for Convention; ASCE Director Frank L. Weaver, who presided at Civil Defense session; and Henry B. Aiken, presiding officer at session of Surveying Division.

Board of Direction Actions Briefed

Action taken by the Board of Direction at its meeting in New Orleans, on March 3 and 4, 1952, are summarized.

Centennial of Engineering

Current progress on general arrangements for the Centennial of Engineering in Chicago, September 3–13, were reviewed. The Committee on Publications was instructed to study the possibility of publishing a special volume of TRANSACTIONS covering a history of 100 years of civil engineering.

Unity of Organization

The Board voted to support a development of Plan A as the basis for an organization for increased unity of the engineering profession, and to defer action until the result of an EJC canvass of the societies of the Exploratory Group is known. The Exploratory Group, by a vote of 14 to 1, had endorsed Plan A. (See item elsewhere in this issue.)

ASCE-AGC Joint Cooperative Committee

The Board endorsed AGC action to obtain remedial legislation by Congress clarifying provisions of federal construction and procurement contracts so that in case of dispute, the judicial review of decisions of a department head can be obtained. It empowered the National Affairs Committee, after conferring with the Committee on Private Engineering Practice and the Executive Committee of the Construction Division, to act for ASCE in its representations to Congress. This action comes as a result of the Supreme Court decision in the Wunderlich Case (page 64 of this issue).

Believing that the owner should decide upon the type of construction and should develop a definite design, the Board also supported AGC in its objection to requesting contractors to submit bids on substitute designs and materials in addition to bidding on basic requirements. Discontinuance of this practice by government construction contract awarding agencies will be requested.

The Board also registered its disapproval of a practice developing in some areas where contractors are required to buy their insurance and surety bonds from an agent or company specified by the owner.

Coordination of Construction Industry Committee

Cooperative action among ASCE, AIA, and AGC was authorized so that technical guidance can be supplied in current problems of national controls of construction materials and related problems in the construction industry.

Surveying Is Engineering

The Board adopted a resolution to the effect that the planning, execution and direction of professional surveying activities constitute professional engineering and that public interests will be best served when such work is directed and performed, as much as possible, by qualified professional engineers. It ordered that the resolution be transmitted to the U.S. Civil Service Commissioner.

Technical Division Study

A task committee of the Executive Committee was instructed to study the Technical Division structure of the Society within the limits of the Constitution and By-Laws and to develop controlling criteria which should be adopted to govern the formation of new divisions, the combination of existing Divisions or the abandonment of Divisions, and to report not later than the June meeting of the Executive Committee.

The Board voted to discontinue the Engineering Economics Division, and to change the name of the Irrigation Division to Irrigation and Drainage Division.

Constitution and By-Laws Codified

Codification of the Society's Constitution and By-Laws by a task committee was presented and approved. The completion of one of the most arduous tasks confronting any Society committee in recent years—the redrafting of the Constitution and By-Laws and a codification of them—was acknowledged to Chairman Arthur W. Harrington by a rising vote of thanks, and his committee was discharged.

Committee Appointments

Malcolm Pirnie to the Hoover Medal Board of Award; Harry S. Rogers to the Alfred Noble Joint Prize Committee; Howard F. Peckworth to the Washington Award Commission; Walter Binger to the Committee on National Affairs; G. Brooks Earnest to the Committee on Awards and Ceremonies; G. G. Greulich, Wm. H. Mueser and Gail A. Hathaway to the Engineering Manpower Commission; Adolph Ackerman as ASCE delegate on the EJC delegation for the UPADI Convention at New Orleans in August 1952; and H. L. Bowman, Rolf Eliassen, Robert T. Colburn and Joseph C. Patchen to a Committee on Atomic Energy.

EMC Letter to Defense Secretary Seeks Better Use of Engineering Manpower

Continuing efforts of the Engineering Manpower Commission of Engineers Joint Council to obtain better utilization of the engineering and scientific manpower of the national industry, government, and the defense program include recommendations for organizing the assignment of Reserve and Draftee engineers. These suggestions of the EMC were transmitted to Anna M. Rosenberg, Assistant Secretary of Defense, by R. E. Gillmor, a member of the Commission.

Mr. Gillmor wrote in part, "...there is now no organized way of insuring the best possible utilization of the individual engineer. One indication of this is to be found in the cases that have come to the attention of the engineering societies which show under-utilization of the engineers in uniform. Another indication is the apparent lack of organized methods for (1) reclassifying Reserve personnel who have obtained degrees since their release from military service after the last war, (2) ordering them to duty in accordance with their classification, or, (3) if no such duty is available offering them for transfer to other branches of the Armed Forces or to civilian activities serving the Armed Forces...."

"The uncertainty in the minds of the ROTC and draft-eligible engineering undergraduates has several ill effects; one of these effects is to make them reluctant to put their undivided energies into their engineering studies. Another ill effect is to make industry feel that it is futile to employ anyone in these categories, with consequent inhibitory effects on the progress of industry, especially those engaged in vitally essential developments for the Military Services.

"We realize that the opinions of technical officers are sometimes presented to the Personnel Boards responsible for deferment of engineers. Nevertheless, it remains true that the technical branches of the Services who have the responsibility for the quality and quantity of weapons and military developments, supplies and equipment of all kinds do not have a corresponding authority over the disposition of engineers who are essential to the efficient execution of this responsibility. This we believe to be a fundamental defect in the organization of the Military Services. The existing procedures for assigning doctors to military service is in great contrast to those now employed for assigning engineers...."

In her reply to Mr. Gillmor, Mrs. Rosenberg expressed the opinion that establishment of an independent procedure for supervising the deferment and assignment of engineering personnel is neither "desirable from the manpower standpoint nor administratively feasible." She conceded that in the technical services, there is a considerable carry-over between civilian skills and military job requirements, but noted that "many of the critical occupational specialties have no direct counterpart in civilian life and require extensive training within the military establishment. These specialties, in many instances, call for the same basic aptitudes and educational foundations in mathematics and related subjects, which are required for civilian engineering or scientific personnel.... The pool of men in the population who are qualified for this type of training and who can, at the same time, meet other basic military qualifications, is a very limited one. To some extent, therefore, it will always be necessary for the armed forces to utilize men with high aptitudes for certain types of training outside their field of civilian specialization. This may appear to be less than full utilization of manpower, when viewed solely from the standpoint of the individual's civilian skills, but represents a very essential aspect of manpower utilization in the light of the overall national defense effort."

Mrs. Rosenberg stated that continuing analyses of requirements for optimum utilization of manpower are being conducted by the Department of Defense, and that special investigations have been made of any reports of alleged improper utilization of personnel, with corrective action taken when the facts warranted.

However, she wrote, the EMC "proposal for establishment of an independent procedure for calling up engineers, with ultimate authority for selection and assignment of specialized personnel, would require Congressional and Executive action similar to that established for the call-up of doctors. The doctors' procedure referred to is a priority of call-up, established by Congress and Executive Order, for securing medical personnel requirements stated by the military departments and approved by the Secretary of Defense. This process is substantially analogous to the placement of a Selective Service call.

"As you know, we have established in the Office of the Secretary of Defense a policy board on reservist delays and discharges, of which a majority of the members are civilians not drawn from the military departments. It is our belief that this board will assure the taking into account of the overall needs of the civilian economy in recommending policies to be administered by the military departments on the recall of reservists."

Denver Section Perfects Plans for ASCE Annual Convention in June

Plans for the Denver Convention of ASCE, to be held June 16-20, are taking definite shape under the auspices of the Colorado Section. Intense attention is being given all committee work to insure that engineers and their families attending the Convention will be received with traditional Western hospitality.

Walter E. Blomgren, president of the Colorado Section and head of the Committee on Technical Sessions, announces that the program is well crystallized, with 18 sessions scheduled to emphasize one hundred years of progress in water projects and power developments. The program will include two sessions of the Irrigation Division, two of the Soil Mechanics and Foundations Division, one of the Structural Division, one of the Construction Division, a joint session of the Structural and Construction Divisions, two sessions of the Engineering Mechanics Division, one of the Sanitary Division, one of the Highway Division, one of the Air Transport Division, one of the Surveying and Mapping Division, one of the Power Division, one of the City Planning Division, and two of the Waterways Division. The detailed program will appear in the May issue.

Celebration at Federal Center

On Tuesday, June 17, a special session will be held at the Denver Federal Center to commemorate the semicentennial of the U.S. Bureau of Reclamation. The morning will be devoted to addresses by Commissioner Michael W. Strauss or one of the assistant commissioners from the Washington office, and to explanations of the growth and activities of the Bureau. Luncheon will be served in the cafeteria near the Bureau laboratories, and the afternoon will be devoted to an open house of all reclamation facilities at the Denver Federal Center.

The committee in charge of student activities has planned a one-day student program for Tuesday. The major part of the program will be devoted to a student paper contest, with Student Chapter members from schools in Colorado, Kansas, Montana, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Utah and Wyoming taking part. These will also be a conference for faculty advisers on June 19.

Field trips will be available to suit the convenience of the delegates. In addition to a one or two-day trip to cover the Colorado-Big Thompson Trans-Mountain Diversion Project, visits to engineering developments in the Denver area, such as the Denver-Boulder toll road, the Cherry Creek reservoir and dam, and several municipal developments in Denver, can be arranged.

On the lighter side, Denver has much to offer for the entertainment and refreshment of visitors. It is the commercial and cultural center of the Rocky Mountain region, with its myriad scenic attractions and rare opportunities for outdoor recreation. Although in the past few years Denver has expanded into a modern city of over 400,000, it retains much of the atmosphere of the old West. Adjoining the city's splendid retail shopping, hotel, and financial district is a $11,000,000 Civic Center, noted for its fine public buildings, broad lawns, trees imported from foreign lands, historical libraries, museums, and art galleries—and the finest Indian collection on the continent. In the Denver City Park is the nationally known Museum of Natural History. The zoo in the park was the first in the country to establish animals in enclosures resembling their native habitats. During the summer, excellent band concerts are conducted against a background of a lighted fountain which gives an extraordinary effect.

Denver's largest park, however, is outside the city—the spectacular Mountain Park System, which covers many thousands of acres on the front range of the scenic Rocky Mountains. This park system includes the highest automobile road in America, which winds to the summit of 14,260-ft Mount Evans, and the Park of the Red Rocks with its world-famous open-air amphitheatre where music, drama, and dancing festivals are conducted all summer. A chuck-wagon dinner in this park is planned as a Convention highlight.

Early Reservations Urged

The Registration Committee is completing plans for handling the registration of delegates at the Convention headquarters—the Cosmopolitan Hotel in Denver. Reservations will be accepted by the Housing Chairman of ASCE, care of the Denver Convention and Visitors Bureau, 225 West Colfax Avenue, Denver, Colo. Rates at the Cosmopolitan range from $5 for a single room to $13 and up for a suite for three or four. Other hotels having accommodations available are the Albany, with rates from $3.50 for a single room to $8.50 and up for a suite; the Brown-Palace, with rates from $4.50 for a single room to $8.00 for each room in a suite; and the Shirley-Savoy, with rates from $3.00 for a single room to $8.00 for a suite.

View through classic columns of beautiful Cheesman Park Memorial Pavilion in Denver (upper right) reveals inspiring panorama of 150 miles of Colorado Rockies including the Continental Divide. Colorado State Capitol Building and colonnades of Denver Civic Center are shown in lower right photo.

California Sections to Hear President Proctor at Fifth Annual Conference

A special feature of the fifth annual California Conference of Local Sections, to be held at the U.S. Grant Hotel in San Diego, May 2 and 3, will be the presence of the ASCE Executive Committee and President Carlton S. Proctor, who will be the principal speaker at the dinner meeting Friday night. The Executive Committee will hold its interim meeting concurrently with the conference. Registration will start, Thursday, May 1, and there will be an informal "get-together" with entertainment and refreshments Thursday evening.

The outstanding program includes a choice of field trips to one of the following engineering projects in the San Diego area: The Alvarado Filtration Plant, shown in the accompanying illustration; the Naval Auxiliary Air Station at Miramar; and the Silver Gate Steam-Electric Generating Station.

Since this is the ASCE centennial year, the San Diego Section is exerting every effort to make the conference one that will long be remembered. The program, which will cover a wide range of engineering subjects, is given here.

Friday, May 2

Morning Meeting (Chairman, Clement T. Wiskocil, president, San Francisco Section)

8:00 Breakfast Round Table, students and members

9:30 "Urban and Interurban Problems of Mass Transportation," by Prof. Harmer E. Davis, director, Institute of Transportation and Traffic Engineering, U. of Calif.

10:00 "Electric Power Program and Requirements in California," by ASCE Director Wallace L. Chadwick, Southern California Edison Co.

10:50 "Basic Concepts of Prestressed Concrete," by George Youngclaus, field engineer, Portland Cement Association

12:15 *Luncheon* (Chairman, Alden K. Fogg, president, San Diego Section) "Human Relationships," by F. T. Letchfield, consulting engineer and assistant vice-president, Wells Fargo Bank and Union Trust Co., San Francisco

Afternoon Meeting (Chairman, Roy L. Anderson, president, Los Angeles Section)

2:00 "Municipal Incineration Performance," by A. F. Bush, assistant professor of engineering, U.C.L.A.; Stewart Mulford, lecturer in engineering, U.C.L.A.; and Ralph Stone, associate research professor of engineering, U.C.L.A.

2:30 "Experimental Studies of P-B Venturi Flume," by E. A. Wells, lecturer in sanitary engineering, U. of Calif.

3:00 Panel Discussion (Chairman, R. Robinson Rowe, president, Sacramento Section) "Current Studies by Regional Water Pollution Control Boards in Southern California," by Vinton W. Bacon, executive officer, State Water Pollution Control Board, moderator; "Hall Canyon Study and Polluted Well Water Study in Los Angeles," by Linne Larson; "San Gabriel River Study and Oil Field Waste Water Disposal Study," by Paul G. Brown; and "San Diego Bay Study," by Harold E. Miller

7:00 *Dinner* (Chairman, A M Rawn, Vice-President of ASCE)
Student Paper Competition, with finalists presenting their winning papers. Address by ASCE President Carlton S. Proctor
Entertainment and Dancing

Saturday, May 3

Morning Meeting (Chairman, M. J. Shelton, chief engineer and general manager, La Mesa, Spring Valley, Lemon Grove Irrigation District)

9:30 Business session; resolutions

10:00 "The Engineering Centennial," by ASCE President Carlton S. Proctor and ASCE Executive Secretary W. N. Carey

11:15 Field Trips (briefing by W. J. Bobisch, Chairman)

1:00 Field Inspection Trips

Ladies' Program (Friday)

General Chairman, Mrs. M. J. Shelton

10:00 Chairman of Day, Mrs. J. L. Burkholder
Private cars to Scripps Institute of Oceanography at La Jolla where arrangements have been made for conducted tour. Luncheon at beautiful La Jolla Country Club, followed by cards for those interested. For an additional fee guests may swim in the private pool or play golf. Cars will be available for those wishing to shop in unique shopping center of La Jolla. Cost for the day's trip with luncheon will be $3.

Ladies' Program (Saturday)

10:00 Chairman of Day, Mrs. Paul Beerman
Private cars to Balboa Park. Bus trip through San Diego Zoo followed by talk by Mrs. Belle Benchley, only woman curator in the world. Luncheon on Terrace, House of Hospitality, Balboa Park. Conducted tours through Fine Arts Gallery, Museum of Man and other points of interest in the park have been arranged. Cost for the day will be $3.

Aerial view of Alvarado Filtration Plant, objective of one of Conference trips, shows part of Lake Murray, Murray Dam, wash water tank, and regulating reservoir.

General Committee in charge of arrangements for San Diego Conference shows (seated, left to right) E. W. Blom, Arrangements; G. R. Saunders, secretary of San Diego Section; M. J. Shelton, General Chairman; Dale Diamond (student), R. K. Fogg and Lorin Deewall, Reception. Standing, in same order, are E. A. Lawrence; W. J. Bobisch, Field Trips; A. K. Fogg, president of San Diego Section; R. H. Wilken, treasurer; J. F. Jorgensen and C. M. Cade, Students; C. T. Johnson and Jean Vincenz, Technical; and Quentin Rust, Publicity.

Lohr Explains Centennial Aims to Cincinnati Engineers

Major points which the Centennial of Engineering will disseminate were outlined by Lenox Lohr, M. ASCE, president of the Centennial of Engineering, 1952, Inc., in a recent address, entitled "The Engineer and America," before the Technical and Scientific Societies Council of Cincinnati. Noting that a Centennial presents an obvious opportunity to review and evaluate the accomplishments of the past and from them to chart a probable curve of future progress, Major Lohr said that a more significant aspect of the celebration will be "the unique opportunity it presents to remind our fellow Americans of the factors that have produced our prosperity and the contributions that scientists, engineers, and management have made to it."

He reminded his hearers of the three major Centennial projects—the exhibit at the Museum of Science and Industry, the dramatic presentation and the Convocation—and said that in addition 51 societies with a total membership of over 300,000 have signified their intention of holding their separate meetings in Chicago during the Convocation period, September 3 to 13. Foreign societies, too, are expected to send large delegations, if economic conditions permit. He said that a booklet, listing the hundreds of papers and meetings comprising the Convocation program, will be prepared in advance so that engineers will have an opportunity "to get the latest word on subjects collateral to their own specialty and not otherwise available to them."

During the summer months there will be a dramatic presentation, staged in the auditorium of the Museum of Science and Industry, to tell the story of man's ascent through the ages. Beginning with the mythological concepts of Zeus with his thunderbolts, and Prometheus with his first fire, through the coming of atomic power, man's rise will be traced.

Important as the Convocation will be, Major Lohr said, it would not justify the elaborate preparations or the substantial financial contributions made by industry, if this were the only purpose of the Centennial. "Its primary objective," he emphasized, "to which all other activities will be directed, is to tell the story of America's development to the general public. On an accurate knowledge of the intricate workings of this great industrial empire, their future happiness and prosperity may rest."

Pointing out that recent surveys of high school students "have shown alarming misconceptions of the fundamentals of our industrial structure and the environment of freedom that nurtured it," Major Lohr declared that the Centennial celebration presents a particularly favorable opportunity to stress the factors that have produced our material wealth for the benefit of the "younger generation, which is still in the formative stage. They will determine the social, political, and economic trends of the future; they will build structures on the foundations which we have laid. If we make the most of our opportunity, the Centennial of Engineering can do much to clarify the thinking of many who are bewildered by a world changing more rapidly than their ability to digest it. Even if we are able to make only a small contribution to this end, our efforts will be justified. . . .

"It will take fortitude of high order to stop the ravages of inflation and a deteriorating of confidence in our republican form of government," Major Lohr warned. "The will to do this will come only through widespread knowledge of the factors which have made us great. Despite the dislocations and restrictions on industry, our standard of living has increased, because we had an immense backlog of resources and 'know-how.' Our industries have developed, and are still capable of tremendous production. Even with the increased load of rearmament, the necessities and luxuries of a full life are rolling off the assembly lines as fast as we can absorb them. . . .

"As long as our scientists and inventors devise new things, and engineers and industry can produce them, we have a sturdy bulwark against socialism. As long as we have a constructive dissatisfaction with things as they are and something worthwhile to look forward to, we will prosper and progress." Major Lohr believes that many of the ills that beset the country today could be obviated if they were "considered by what has been called the 'scientific method' or 'engineering approach.'"

The essentiality of the engineer to the defense program as well as to the mass-production technique that has been a contributing factor to the high standard of living in the United States was also stressed by Major Lohr. Deploring the present shortage of engineers and reduced enrollments in engineering schools, he emphasized the fact that, "Wars are won by the productive capacity of a nation to overwhelm the enemy with new devices made in sufficient quantity and delivered in time. The scientist in his laboratory and the engineer in his plant are now in the front line of military operations. . . .

"Every step in the development of the past hundred years has required the services of the engineer. Every step in mechanization, every step in mass production must be engineered. There has been, and will continue to be, the demand for more power, more tools, more engineers. Our material advancement has been due to the production of new things, standardized designs, single-purpose machine tools, efficient utilization of labor, accuracy so that parts may be interchangeable, progressive assembly, and competent management. In this process man has progressed through the nomadic, agrarian, and craftsmanship stages to the mass production of today. . . . But without the freedoms guaranteed by our Constitution and the institution of our system of competitive enterprise neither industry nor the engineer could have given us all that we enjoy. . . .

"The Centennial can be a wide window through which a bright new frontier may be disclosed, promising more thrilling adventure and more new discoveries than were ever possible before, for science is continually devising new means to penetrate the unknown in limitless fields."

In conclusion, Major Lohr urged that his hearers, "as engineers, scientists and citizens, tell the story of the Centennial to all who are willing to listen."

Early Hotel Reservation for Centennial Urged

For attendance at the Centennial Convocation in Chicago, it is advisable to request reservations at the hotel of your choice as soon as plans can be made. The headquarters of the American Society of Civil Engineers will be the Conrad Hilton Hotel, Chicago's largest.

Address requests for reservations at the Conrad Hilton to:

Reservation Clerk, ASCE Convention
Conrad Hilton Hotel
720 S. Michigan Avenue
Chicago 5, Ill.

Professional Unity Plan Receives Board Support

Studies made by ASCE and other engineering groups in the past few years with a view to determining the feasibility of developing an organization to increase unity were reviewed by the Board of Direction at its meeting in New Orleans. As noted in the summary of Board actions (page 57), the Board voted to support a development of the Exploratory Group's "Plan A," described below as the basis for an organization for increased unity, and to defer action until the results of an EJC canvass of the societies represented on the Exploratory Group are known.

Formed for study of the professional unity situation in 1949 at the suggestion and invitation of Engineers Joint Council, the Exploratory Group represents fifteen major engineering societies of the United States. Since its formation the Exploratory Group has held a number of meetings and on December 16, 1950, adopted for purposes of discussion an extensive report prepared by its Planning Committee. This report, which included descriptions of four different plans for establishing a unity organization, has been the basis for wide discussion among the Societies during 1951 of the various problems involved in bringing about increased professional unity. At a meeting on December 15, 1951, the Exploratory Group adopted with one dissenting vote, the report identified as Plan A as its recommendation to the Exploratory Group societies and to Engineers Joint Council. H. S. Osborne is serving actively as secretary of the Exploratory Group.

The general conclusions of the Exploratory Group are as follows:

"1. It is desirable that the engineering profession establish a 'unity organization' which will be able to advance the unity of the profession and the service of the profession to the nation.

"2. The unity organization should be formed by the modification and development of a present organization or by the integration of two or more present organizations rather than by the establishment of an entirely new organization.

"3. The unity organization should initially include the participation of a majority of the national engineering societies represented in the Exploratory Group.

"4. There are a number of important questions regarding the form and activities of the unity organization and its relation to other engineering bodies on which there are differences of opinion within the profession. Accordingly, it is desirable that the unity organization be launched in the simplest possible way and that these questions be studied and determined by the unity organization itself rather than by the Exploratory Group or any other temporary group.

"5. To bring about this first simple step the Exploratory Group recommends to Engineers Joint Council that it invite all constituent societies represented in the Exploratory Group to become constituent societies of the Council.

"6. The Exploratory Group recommends further that, coincident with this invitation, Engineers Joint Council modify Article II—'Membership' of its Constitution in such a way as to provide for membership on the Council by representatives of the constituent societies appointed or elected for the purpose, and to provide for a number of representatives from each society, ranging from one to three.

"7. The Exploratory Group recommends to the constituent societies of the Group that they accept the invitation of EJC and become constituent societies of that body."

Organizations represented on the Exploratory Group are the American Association of Engineers, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society for Engineering Education, the American Society of Civil Engineers, the American Society of Heating and Ventilating Engineers, the American Society of Mechanical Engineers, the American Society of Refrigerating Engineers, the American Water Works Association, the Illuminating Engineering Society, the Institute of Aeronautical Sciences, the Institute of Radio Engineers, the National Society of Professional Engineers, and the Society of Naval Architects and Marine Engineers.

At its meeting in New Orleans the Board expressed to ASCE Past-President R. E. Dougherty "its sincere appreciation for his diligence and effectiveness in all the deliberations . . . toward the development of an organization for increasing unity of the engineering profession."

Engineers Joint Council Acts

At its March 21 meeting EJC requested its Committee on Constitution and Bylaws to submit for approval suitable changes to its constitution to provide for additional membership on Council.

What Is the Structural Division Doing?

ERNEST C. HARTMANN, M. ASCE, Chairman of Committee on Promotion of Member Participation in Technical Activities, Structural Division, ASCE

The March issue of CIVIL ENGINEERING (page 57) described a new venture of the Structural Division and promised a description of the work of its technical committees. Here the work of five committees is described briefly by the respective committee chairmen; the work of the remaining six will be described in the May issue. Members of the Society who are interested may write to members of the committees in their locality or to E. C. Hartmann, P. O. Box 772, New Kensington, Pa. A full roster of the committees is in the Official Register for 1952. James P. Michalos, Iowa State College, Ames, Iowa, should be added to the Committee on Deflection Limitations of Bridges.

Committee on Design in Lightweight Structural Alloys

This committee, of which C. N. Gaylord is chairman, has devoted most of its time to the development of specifications for the design in aluminum alloys of structures of interest to civil engineers. "Design Specifications for Structures of High Strength Aluminum Alloy" was published by the Society as Proceedings Separate No. 22. This specification covers only one high-strength aluminum alloy known commercially as 14 S-T6. "Specifications for Structures of a Moderate Strength Aluminum Alloy of High Resistance to Corrosion" has been accepted by the Society for publication. A paper entitled "aluminum Alloy Storage Vessels," by E. C. Hartmann and F. L. Plummer, was sponsored by the committee at the Houston Convention of the Society and printed in the February issue of CIVIL ENGINEERING.

An explanation of the need for a specification for magnesium alloys revealed so little interest that the committee decided not to pursue the matter further. The committee is conferring with the American Iron and Steel Institute on the advisability of preparing design specifications for stainless steel.

Members of the Society can be of great assistance by forwarding stress-strain and tangent modulus data for lightweight structural alloys to the committee.

Committee on Factors of Safety

The first step in the work of the committee, of which O. G. Julian is chairman, has been the definition of the "Factor of Safety." The considerable disagreement

between the committee members on this point, which became evident at the start of the work, showed the importance of this step. After extensive discussion a sufficient measure of professional agreement was achieved to establish a further course of action for the committee. Such action, as at present envisaged, has three aims:

1. The collection of data relevant to loads and load effects on various types of structures—for instance, distribution of vehicle weights and axle loads and relations between travel velocities and spacings for bridges, actual conditions of live load for buildings, wind velocities—and their evaluation and presentation as statistical distributions.
2. The collection of data relevant to the resistance and strength of structural materials, such as elastic modulus, yield limits, building strength, fatigue and endurance limit, and their evaluation and presentation as statistical distributions.
3. The development of a procedure of computation on the basis of which collected data could be correlated and used to determine numerical values of safety factors, associated with specified probabilities of survival under various extreme conditions.

The committee recognizes that considerable educational effort will be required within the profession to make the practicing engineer conscious of the complexity and ambiguity of such assuredly simple everyday engineering concepts as "load," "working stress" or "safety factor," and it will attempt to prepare, promote, and encourage publications dealing with those subjects, particularly those dealing with the application of the concept of probability in their analysis.

Committee on Semi-Rigid Beam-to-Column Connections

The purpose of the committee, of which W. H. Weiskopf is chairman, is to appraise the present status of riveted semi-rigid beam-to-column building connections, using a report of the American Institute of Steel Construction (Progress Report No. 1, "Riveted Semi-rigid Beam-to-Column Building Connections" by R. A. Hechtman and B. G. Johnston) as a starting point; to make recommendations on the range within which use of this type of construction is feasible, and the manner in which it can be used; to indicate the direction of further research if such is required.

At the present time a comparison is being made of the various suggested design methods using laboratory measurements, where available, as a standard.

Committee on Deflection Limitations of Bridges

This committee, under the chairmanship of G. S. Vincent, was organized primarily to study the propriety of the AASHO bridge specifications limiting the depth ratios and live-load deflection of bridges. It has looked into the historical development of this type of specification and studied questionnaires returned from state highway departments dealing with observed bridge vibration and expressing views regarding these specifications and the general problem involved. Test reports on the vibration of a number of bridges have been examined, and the factors involved in a rational basis for limiting vibration and other effects of deflection discussed.

The present committee finds itself in the position of a committee near the turn of the century which was unable to point to any criterion other than "judgment." Bridge engineers are perhaps the severest critics of their bridges in this respect, and even the more conspicuous vibrations of highway bridges are less severe than is commonly experienced on railroad bridges, but many railroad bridges have been damaged by vibration. Vibration is influenced by other factors besides flexibility, and flexibility may be objectionable for other reasons than vibration.

A thorough theoretical analysis has been started at the University of Illinois, and the Bureau of Public Roads has assembled equipment in preparation for tests on highway bridges, profiting by the experience gained by the railroads in earlier research of this kind. Pending completion of these tests and studies, the committee cannot make basic recommendations, although some improvement may be made in the specified assumptions for calculating the limiting deflection.

Committee on Measurement of Dead Load Stresses in Mississippi River Bridge

This committee, of which W. H. Jameson is chairman, was formerly a subcommittee of the Committee on Design of Structural Members, functioning under Prof. L. T. Wyly as chairman. Under his active supervision, strain-gauge and rotation measurements have been made on truss members, gussets and shoes at, or adjacent to, one of the main bearing points of the East St. Louis Bridge over the Mississippi River. The group that made these measurements is now preparing the report, which it is hoped will indicate the distribution of primary and secondary stresses at this point. When the original parent committee was dissolved, this committee was made a "task" committee, to review the report, and make recommendations to the Executive Committee of this Division concerning its disposition rather than to make the measurements and prepare the report itself.

New J. Waldo Smith Fellowship Announced

Availability of a new J. Waldo Smith Hydraulic Fellowship to graduate students interested in the advance study of hydraulics is announced by the award committee. A comprehensive investigation of a timely subject in the field of hydraulics or hydraulic engineering is proposed by the Committee, which states that the project should be geared to completion within a year with the production of some interesting and useful information. Applications must be in the hands of the chairman, W. H. Nalder, care of the Bureau of Reclamation, Denver Federal Center, Denver, Colo., by May 15, 1952, and the announcement of the award will be made shortly thereafter.

As in the past years, the fellowship will be of joint interest to the graduate student and the institution through which he will work, and the applications should be routed through the institutions themselves.

Established by the Society in memory of J. Waldo Smith, former chief engineer of the New York City Board of Water Supply, the fellowship currently carries a stipend of $1,000, plus an allowance for equipment up to $400.

Conditions of administering the fellowship are given in the current 1952 Official Register, recently mailed to all members.

Preprints of New Orleans Convention Papers Available

In an innovation first tried out at the New Orleans Convention, photocopies of a number of the papers scheduled for presentation at the various sessions were made available. In all, 27 separate manuscripts were received at Society headquarters in time for reproduction by a photolithographic process. A common reduction in size was effected to provide individual pamphlets, $5^1/_2 \times 8^1/_2$ in. in size. Tabulations, line drawings, and photographs all reproduced satisfactorily.

Nine of the Technical Divisions are sponsoring the papers, which are listed in the order form provided for the purpose in the advertising section of this issue. A uniform price of 25 cents a copy prepaid has been set. Since this does not begin to cover the cost, continuation of the plan will depend somewhat on the demand. To avoid confusion with other Society publications, orders should be placed by preprint number, as listed in the order blank.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Control of Steel Eased

The long-awaited revision of the NPA construction order was issued on March 6, with some last-minute liberalization in the use of steel. It supersedes CMP Reg. 6, Order M-4A and Direction I to CMP-Reg. 6. This new order, revised CMP-Reg. 6, the original draft of which was designed further to tighten controls finally emerged as an order somewhat easing the existing restrictions.

Five tons of steel, including two of structural products, may be self-authorized each quarter for a public or commercial construction project. Wide-flange beams may not be self-authorized. The previous order permitted only two tons of steel.

Road projects may use up to 25 tons of steel, including two tons of structural items, per total project, not each quarter. Previously only two tons per quarter could be self-authorized.

In addition, foreign and used steel may be employed as non-controlled items provided the construction involved uses no extra copper or aluminum. As a result aluminum wire may be self-authorized at the rate of one pound of aluminum for each two pounds of copper wire saved.

Order M-100 deals with housing, which was not covered in the revised general construction order mentioned above. An increase in the amount of steel of a quarter ton per housing unit is permitted. Some further restriction is made on the use of copper.

Apparently the supply of steel available is increasing. The Steel Screening Committee has brought more realism into requests for allotments, the military has not used all that it was believed to need, and the construction industry organizations have presented a forceful case for easing the restrictions. The Construction Industry Advisory Committee to NPA did a splendid job in advising NPA of the industry viewpoint.

The steel supply for the last half of the year should be sufficient to warrant presently undertaking the design of some postponed projects. Some architect's offices which were suffering from lack of immediate design work should experience a degree of relief. Intelligent designing is more necessary than artificial restrictions on materials. Wide-flange beams, large and heavy plates, and many copper items will not be readily found for some time to come. The copper shortage is tied in with price controls which permit foreign buyers to obtain foreign copper at prices above our ceiling.

Although there is considerable demand for the abolition of price and materials controls, it is more than likely that the Defense Production Act, due to expire June 30, will be extended, with some modifications. An amendment to be submitted by Senator Bricker would exempt registered professional engineers employed by any firm of engineers from the control provisions and hence from the salary stabilization regulations.

National Water Policy Legislation Released

A "Water Resources Act of 1951" in the form of a Committee Print, not yet introduced as a bill, is available. This document constitues the legislative recommendation of the President's Temporary Water Policy Commission. An important feature of the proposed bill provides for the establishment of more than 15 River Basin Commissions to coordinate activities of existing federal agencies. There would also be a Federal Board of Review to coordinate the work of these commissions, survey federal water law, and report broadly on the field covered. The Bureau of the Budget is reviewing the whole subject of water-policy legislation. It has not yet reported its views, which may vary from those of the Water Policy Commission.

Missouri Basin Survey Commission Appointed

The eleven-man Missouri Basin Survey Commission, appointed by President Truman, is under the chairmanship of James E. Lawrence, editor of the *Lincoln Star*, Lincoln, Nebr. Senator Hennings is vice-chairman. An organizational meeting will be held in Kansas City during the first week of April. It is expected that the offices of the Commission will be located somewhere in the Missouri Basin.

A round-table discussion on "Who Should Develop Our Water Resources?" will be a feature of the coming annual meeting of the U.S. Chamber of Commerce in Washington, on April 29.

ASCE MEMBERSHIP AS OF MARCH 10, 1952

Members	8,042
Associate Members	10,239
Junior Members	15,994
Affiliates	66
Honorary Members	37
Total	34,378
(March 10, 1951	31,903)

Salary Stabilization Liberalized

General Salary Order No. 8 of the Salary Stabilization Board permits increased compensation for professional engineering employees who work longer than the normal work week. Salary Procedural Regulation I details procedures for filing applications for salary adjustments.

The Office of Salary Stabilization has stated that its attention has been called to some bad practices involving "pirating" of engineers and then selling back their services at a very considerable increase over their previous salary. It announces that a nationwide survey will be undertaken to obtain information dealing with "job-hopping and worker-piracy." The results of the survey will be used as a basis for regulatory action. The EJC Engineering Manpower Commission is working on this problem.

Regional offices of the Salary Stabilization Board have been opened in New York, Boston and Detroit. Offices will soon be established in Philadelphia, Cleveland and San Francisco. The local offices of the Wage and Hour Division of the Department of Labor are also available for information and assistance.

The Secretary of Commerce has requested the cooperation of industrial and professional groups in making the Office of Technical Services of the Department of Commerce a clearing house for ideas which will help step up the nation's productivity. Ideas relating to safety, cost-reducing techniques and time-saving devices developed in a plant or on a job are wanted.

Contract Disputes

In the recent Wunderlich Case the Supreme Court has held that the ruling of a government contracting officer in a dispute on a contract is final on questions of fact unless fraud is alleged and proved. This case related to a general contractor (see CIVIL ENGINEERING for February, page 58). The same provision is found in most contracts for engineering services with the government. Two bills —H. R. 3601 and H.R. 6338—have been introduced to offset this decision and permit review by the Court of Claims. Hearings have been held on these bills.

Washington, D.C.
March 21, 1952

Wisconsin Section Sponsors District 7 Conference

On May 9 and 10 the Wisconsin Section will be host to members of Local Sections comprising District 7—located in upper Michigan, Minnesota, North Dakota, South Dakota, and parts of Saskatchewan and Manitoba. The two-day program will feature the presentation of papers on the vital subject of lake levels and beach erosion on the Great Lakes by Milton P. Adams, executive secretary of the Michigan State Water Resources Commission; Eugene Howard, Milwaukee County Commissioner of Highways; and Col. W. N. Harris, district engineer for the U.S. Lake Survey, Detroit.

Friday morning, May 9, will be devoted to registration, beginning at 9 a.m., and several business meetings. There will be a noon luncheon at the Blatz Brewing Co., followed by a tour of the plant and inspection trip to the Milwaukee Filtration Plant. The three technical papers are scheduled for presentation on Saturday morning. The meeting will adjourn after lunch.

Headquarters for the two-day conference will be the Plankington Hotel in Milwaukee. Inquiries may be addressed to Edward A. Korpady, 2709 South 52nd Street, Milwaukee 15, Wis.

District 9 Council to Meet in Dayton, Ohio

The Dayton Section will be host to a two-day convention of Local Sections in District 9 on April 18 and 19. A District 9 Council meeting, under the chairmanship of C. Russell Dole, will constitute the Friday morning program. ASCE Vice-President Daniel V. Terrell will be the principal speaker at a luncheon that noon, and President Carlton S. Proctor will speak at the evening banquet. Inspection trips to points of engineering interest in the Dayton area are scheduled for the afternoon.

There will be a District 9 business meeting and reports on Saturday morning. Guest speakers will be Wayne Hopkins, of the Miami Valley Council of Boy Scouts of America, and Herbert Starick, city manager of Middletown, Ohio. Arthur Morgan, of the Miami Conservancy District, will address a luncheon meeting that noon.

The conference theme will be "one hundred years of engineered progress as a challenge to the profession to bring peace and prosperity to mankind in the next century."

ASCE members living in Finland and members of Finnish Society of Civil Engineers meet in Helsinki to discuss ways of increasing cooperation between the two groups. Shown, left to right, are Esko Arhippainen; H. Sistonen; J. Vuorinen; Osmo Korvenkontio, secretary; A. Junttila; V. Axelson; Beato Kelopuu, chairman; and Viljo Rinne.

Contributors to Centennial Financing Listed

Contributions toward financing the Centennial program are being received by Centennial of Engineering, 1952, Inc., the corporation formed to direct over-all phases of the program. An intensive campaign is under way to complete the financing. Contributors to the financing fund, as of March 13, are announced by Frank W. Edwards, M. ASCE, general manager of the Centennial, and listed here.

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J. G. White Eng. Corp.

Coming Local Section Events

California Conference of Local Sections will meet at the U.S. Grant Hotel, in San Diego, Calif., May 1–3.

Central Ohio—Dinner meeting at the Ohio Union, Ohio State University campus, Columbus, on April 17, at 6:30 p.m.

Cleveland—Meeting at the Cleveland Engineering Society, on April 18.

District 9 Council will meet in Dayton, Ohio, April 18 and 19.

District 7 Conference will meet at the Plankington Hotel, Milwaukee, Wis., May 9–10.

Indiana—Northwest Sub-Section will meet in South Bend, on April 22.

Los Angeles—Annual Junior Forum spring banquet at the French Cafe, Montebello, on April 17, at 7 p.m., preceded by cocktail hour at 6 p.m. Weekly Friday luncheon meeting at the Hotel Alexandria.

Maryland—Dinner meeting at the Engineers Club of Baltimore, on April 28, at 8 p.m.

Metropolitan—Meeting in the Engineering Societies Building, 33 West 39th St., New York, on April 16, at 8 p.m. Junior Branch will hold meetings on April 9 and 23, in the ASCE Board Room, New York.

Nebraska—Luncheon meeting and participation in the Nebraska Engineering Society Spring Roundup, in Omaha, on April 26, at 12 noon.

Northeastern—Joint dinner meeting with Boston Society of Civil Engineers, at Northeastern University, on April 15. Dinner in connection with the New England Conference of Student Chapters, April 26.

Northwestern—Dinner meeting in the Junior Ballroom, Coffman Memorial Union, University of Minnesota, on May 5.

Pacific Northwest Conference to be held in Richland, Wash., on May 15–17.

Providence—Meeting at the Providence Engineering Society, on April 10. Annual dinner and election of officers at the University of Rhode Island, Kingston, May 1

(*Continued on page 68*)

Scheduled ASCE Conventions

DENVER CONVENTION
Cosmopolitan Hotel
Denver, Colo., June 16–20, 1952

CENTENNIAL CONVOCATION
Conrad Hilton Hotel
Chicago, Ill., September 3–13, 1952

SAN FRANCISCO CONVENTION
San Francisco, Calif., March 2–7, 1953

Head table at annual dinner meeting of Venezuelan Section, held in Caracas on March 4, shows (left to right) Francisco J. Sucre; Mrs. Arturo Valery; George McCammon; Mrs. Santiago Vera; Gerardo Sanson, Minister of Public Works; Edmundo Curiel, retiring president of Section; Santiago Vera, Minister of Mines and Hydrocarbons and speaker of evening; Mrs. Edmundo Curiel; Gerald O'Connor; Mrs. Manuel F. Mejias; Gabriel Disario, past-president; and Arturo Valery Pinaud, retiring secretary. New Section officers are Edwardo Arnal, president; Gerald A. O'Connor, vice-president; Mariano Salas Berti, secretary; and Bernardo Nouel, treasurer.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	February 19	30	Luncheon meeting. George F. Finn, works superintendent, Buffalo Sewer Authority Treatment Works, presented a talk on pollution.
Central Ohio	February 21	90	Joint dinner meeting with Ohio Society of Professional Engineers. Elmer A. Keller, director of Public Service for the City of Columbus, acted as moderator for a panel which discussed utility service for Columbus.
Central Illinois	January 29	42	W. W. Hay, assistant professor of railway civil engineering, University of Illinois, described a study he conducted for Southern African governments, at a dinner meeting.
Cincinnati	February 6	55	A demonstration of "An Experimental Special-Purpose Concrete" was performed by Prof. Robert T. Howe, civil engineering department, University of Cincinnati. Newly elected officers including Harry A. Balke, president; Sven E. Sjodahl, vice-president; and George J. Kral, secretary-treasurer; will be inducted on May 7.
District of Columbia	January 29	146	Luncheon meeting addressed by Newbold Noyes, editor of the *Sunday Star* of Washington, D.C.
	February 19	147	Annual dinner meeting. ASCE President Carlton Proctor spoke on "A Century of Engineered Progress." Guest speaker, Dr. Alberto Lleras, spoke on the subject, "A Challenge, the Building of a Continent."
Duluth	January 21	...	Newly elected officers for 1952 are Walter Hurtley, president; Robert Rhode, first vice-president; John Fredin, second vice-president; J. E. Bovee, secretary; and L. N. Knutson, treasurer. A talk was given on bonding the contracting business, by Charles Liscomb, of Liscomb-Hood, Bondsmen.
	February 18	...	R. W. Marsden, Oliver Iron Mining Corp., presented an illustrated talk on the Labrador Iron Ore Deposits.
Florida	February 20	...	Dinner meeting in honor of President of ASCE, Carlton Proctor.
Georgia	March 7	102	Luncheon meeting. M. L. Shadburn, state highway engineer chief, gave a talk on the Georgia State Highway Department.
Indiana	February 19	70	Prof. R. B. Wiley, head, School of Civil Engineering and Engineering Mechanics, Purdue University, spoke on "A National Water Policy."

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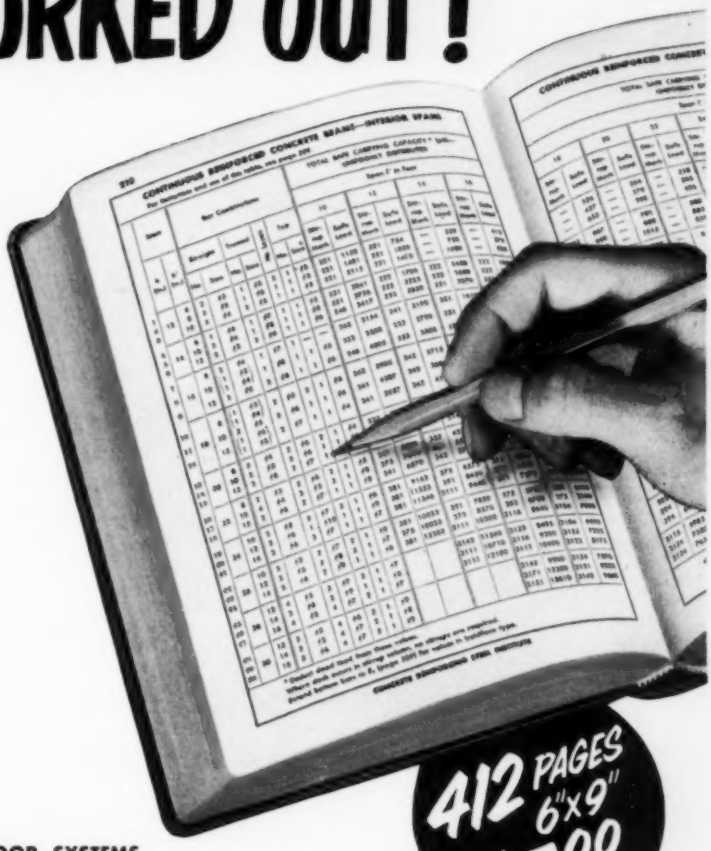

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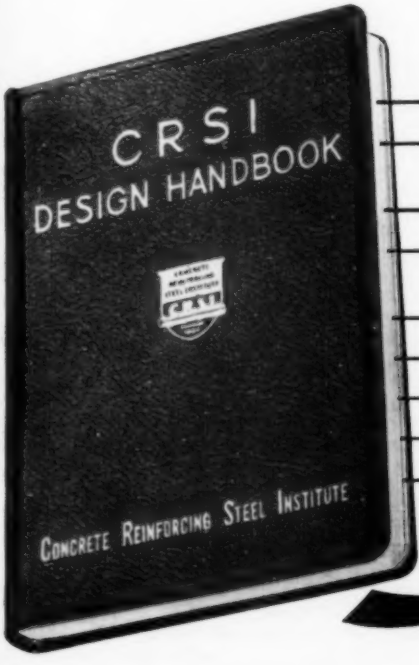

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Los Angeles	February 13	172	Civil and Military Works Program of the Los Angeles District, Corps of Engineers, presented by Norris Bostwick and William H. Spear, chief, civil design section, Los Angeles District.
Junior Forum	January 26	150	Field trip through Pershing Square Garage and discussion of design and construction.
	February 13	...	Ted McConville, associate highway engineer, covered the historical and planning background of the Freeway System.
Maryland	February 13	120	Dinner meeting. Roy H. Ritter, Whitman, Requardt and Associates, consulting engineers described the proposed Ashburton filtration plant in Baltimore.
Metropolitan	February 20	225	Captain Emil H. Praeger, partner, Praeger-McGuire, gave a talk entitled "The Design and Construction of Pier 57, New York."
Miami	February 7	31	Dinner meeting. Discussion of "Engineering Problems of Our City," was presented by Arthur E. Darlow, director of engineering, City of Miami.
Mid-South Jackson Branch	February 13	200	Joint meeting with Mississippi Section, American Institute of Electrical Engineers, Illuminating Engineering Society, and Mississippi Society of Professional Engineers. Guest speaker for the evening was Dr. Maurice E. Strieby, American Telephone and Telegraph Co., New York, N.Y.
North Carolina	February 18	118	ASCE President Carlton Proctor was honored at special winter meeting and dinner.
Nebraska	February 27	47	An outline of the aims and activities of the Joint Committee on Professional Practice was given by Prof. L. B. Smith, head of department of architecture, University of Nebraska.
Philadelphia Delaware Sub-Section	February 19	60	Dinner meeting. Nomination for officers for 1952–53.
Pittsburgh	February 19	73	Joint meeting with the civil section, ESWP, addressed by Herbert Condon, staff assistant, training department, Aluminum Company of America.
Providence	February 14	60	Joint meeting with Rhode Island Society of Professional Engineers. Col. E. A. Flanders, assistant to division engineer, New England Division, Corps of Engineers, and Kenneth Linnell, director, Soils Laboratory and Frost Effects Control Research, Corps of Engineers, were the speakers for the evening.
Sacramento	February 26	145	Hal Harned, supervising geologist, State Bridge Department, spoke at the weekly luncheon meeting.
San Diego	January 22	55	Annual dinner dance. Life membership certificates awarded to William F. McDonald and M. L. Enger.
	February 22	60	Subject for W. G. Sloan's talk was the report of the Water Policy Commission.
San Francisco	February 19	...	Jack Carlson, general sales manager of Kaiser Steel Co., presented a speech entitled "The Steel Outlook—Picture for the West."
St. Louis	January 28	80	Conway B. Briscoe, director of public utilities, City of St. Louis, spoke on future planning in mass transportation, water supply and airport development for the city.
	February 25	98	Luncheon meeting. Progress and plans of the Bi-State Development Agency for the St. Louis metropolitan area were discussed by Milton M. Kinsey.
Tri-City	February 26	46	Joint meeting with the Iowa-Illinois Section of ASME featured a talk on engineering statistical control presented by Ernie Fay, manager of quality control for Deere and Co., Moline, Ill.
Virginia	February 16	...	Annual meeting. Program for the day included an inspection trip to dredging operations of Southern Materials Co., on James River; afternoon business meeting; and a banquet attended by 144, highlighted by an address by ASCE President Carlton Proctor. Life membership certificates were awarded to G. M. Harbert and H. M. Church. Newly elected officers include W. C. Roberts, president; J. W. Roberts, first vice-president; T. E. Shelburne, second vice-president; C. S. Mullen, third vice-president; S. R. Navas, secretary; and E. C. Coile, treasurer.

Sacramento—Weekly luncheons every Tuesday at the Elks Temple, at 12 noon.

San Francisco—Dinner meeting at the San Francisco Engineers Club, on April 15.

Tennessee Valley—Registration for the spring meeting will begin at 8:30 a.m., May 10 at the Oak Terrace, Oak Ridge, Tenn. The all-day program will feature a talk by Dr. D. S. Billington, director of the Solid States Institute at Oak Ridge National Laboratory. Holston Sub-Section meeting at the Franklin Club, Elizabethton, on April 15, at 6:30 p.m. Oak Ridge Sub-Section meeting in the West Lounge, Oak Ridge Recreation Hall on April 24, at 8 p.m.

ASCE Members Invited to Attend CIGRE Conference

At a recent meeting of the U.S. National Committee of CIGRE (International Conference on Large Electric High Tension Systems) plans were formulated for United States participation in the fourteenth biennial session of CIGRE, to be held in Paris, May 28 to June 7. With 1,500 delegates from 40 different countries in attendance, the conference will be devoted to a discussion of problems relating to the generation, transmission, and distribution of electric power. The agenda includes 120 technical papers, of which thirteen will be by United States engineers.

Arrangements are being made for a large and representative United States delegation to attend. Further information and registration forms may be obtained from Frederic Attwood, chairman, U.S. National Committee of CIGRE, 50 Church Street, New York 7, N.Y.

University of Arkansas Student Chapter honors Ben W. Dees (left) upon his retirement as Contact Member for Chapter after 18 years of service. Photo taken during annual meeting of Mid-South Section in Little Rock, Ark., shows Mr. Dees receiving fountain pen and pencil set from Charles Kimberling, Student Chapter president.

Horton Penstocks Installed at Snake River Hydro Plant

The C. J. Strike hydro-electric development—located on the Snake River at Mountain Home 60 miles southeast of Boise—is the sixth plant in the Idaho Power Company's postwar expansion program designed to meet ever increasing power demands in the area. This new $20,000,000 project consists of a 3,200-ft. earth fill dam, with a concrete spillway, and a powerhouse with three 30,000-Kva generating units.

Essential to the operation of the powerhouse turbines at the C. J. Strike development are three 22-ft. diam. Horton welded steel penstocks. These structures were fabricated and erected by the Chicago Bridge & Iron Company illustrating, once again, our versatility in meeting the steel plate requirements of industry and power throughout the world. Other recently built Horton penstocks are in service at the Buggs Island Dam, Roanoke, Virginia—the Clark Hill Dam, Augusta, Georgia—and the Bartletts Ferry Dam, Bartletts Ferry, Georgia.

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NEWS BRIEFS . . .

Emergency Construction Problems Studied at AGC Annual Convention

The increasing problems faced by the construction industry in a period when record demand for civilian construction of all types is in competition with the defense program for conservation of critical materials formed the principal business of the 33rd annual convention of the Associated General Contractors of America, held in Detroit, Mich., February 25–28. More than 1,000 leading contractors from all over the United States and Alaska attended the four-day meeting.

Frank R. Creedon, assistant administrator for facilities and construction of the National Production Authority, Washington, D.C., told the group that from now on commercial construction is going to receive more favorable consideration in the distribution of critical materials, especially in areas where unemployment is a problem. He indicated that structural steel supply in the third and fourth quarters of 1952 would be more ample except for heavy construction. He referred to NPA approval of 645 new projects, mostly religious and municipal buildings, which have been assured materials in the third quarter. However, no new starts will be granted in industrial construction in the second quarter, because of the much greater steel requirements of industrial building. To make his point, Mr. Creedon referred to the backlog of $800,000,000 worth of commercial construction awaiting authorization. The 1,100 jobs involved would require about 70,000 tons of steel. In comparison, he said, one new steel plant being built in New Jersey will alone require 165,000 tons of structural steel.

Other government leaders appearing on the program were John L. Haynes, director of the Building Materials Division of the NPA, who said that at least 800,000 new private homes will be built this year and predicted "a good construction year ahead"; Thomas G. Letchworth, chief of the Construction Section, Building Materials Branch, Office of Price Stabilization, who explained Ceiling Price Regulation 93; and Riggs Shepperd, assistant administrator, Rural Electrification Administration, who discussed "The REA Program for 1952."

A $3,000,000,000 Army and Air Force construction program that will encircle the globe and provide the sinews of defense for the country, is well under way, Lt. Gen. Lewis A. Pick, M. ASCE, Army Chief of Engineers, revealed in another leading talk. The construction problems faced overseas are tremendous, he said. "Building is in progress in climates where heavy construction on this scale has never been attempted. Construction techniques are being pioneered in temperature ranges from 40 deg below to 140 deg above zero." General Pick termed the supply of materials the "knottiest problem in the entire job."

Spokesman for the Navy construction program was Rear Admiral Joseph F. Jelley, M. ASCE, chief of the Bureau of Yards and Docks. Economy will continue to be the Navy's watchword in stretching its appropriations for vitally needed shore structures Admiral Jelley declared. He advised of the Navy's determination to hold the line on competitive bidding on construction jobs, including those for the stepped-up program made possible by $800,000,000 voted by the 82nd Congress.

The country's tremendous highway construction needs were stressed in the AGC annual report, presented by H. E. Foreman, managing director, and in an address by A. C. Clark, deputy commissioner of the Bureau of Public Roads, entitled "Highway Construction Progress." An action program for obtaining enactment of improved state highway legislation and increased highway financing was presented by Lawrence A. Rubin, executive director of the Michigan Good Roads Federation. Mr. Foreman's report also emphasized the necessity for "sound advance planning of the increasing backlog of needed construction so that this work can be started promptly when materials are available and controls are relaxed."

Resolutions adopted during the convention urged relaxation of construction controls as soon as possible consistent with national defense needs; early relaxation of the credit controls in Regulation X as they apply to commercial, multi-story, and single-family housing projects; adoption of the AASHO recommendation of a federal-state highway authorization of $810,000,000 for each of the fiscal years 1954 and 1955 "as the minimum essential to prevent further deterioration of the highway system"; and enactment of legislation conferring on the courts jurisdiction to review any decision by a contracting officer or department head that is unreasonable or unjust. Other resolutions reaffirmed previous recommendations for undivided responsibility in award of construction contracts, and opposition to the valley authority type of legislation.

At the close of the meeting Arthur S. Horner, A.M. ASCE, of the A. S. Horner Construction Co., Denver, was elected AGC president for next year, succeeding Glen W. Maxon, of Dayton, Ohio. The new vice-president is C. P. Street, of the McDevitt & Street Co., Charlotte, N.C.

AGC officers for 1952 are, left to right, H. E. Foreman, managing director since 1940; C. P. Street, Charlotte, N.C., vice-president; A. S. Horner, A.M. ASCE, Denver, Colo., president; and William Muirhead, Durham, N.C., reelected secretary-treasurer.

Contract Given for H-Bomb Facilities

An $11,000,000 contract for building equipment necessary for generating, carrying, and using electric power at the huge Savannah River Project of the Atomic Energy Commission has been awarded to the Westinghouse Electric Corp. Included in the contract are three turbo-generators, eighteen large transformers, and a considerable number of low-voltage circuit breakers and unit substations. The contract was received from the E. I. du Pont de Nemours Co., which is building the plant.

Pennsylvania and New Jersey Turnpikes to Be Connected

Adoption of the route for a 33-mile eastern extension of the Pennsylvania Turnpike is announced by the Pennsylvania Turnpike Commission. The four-lane highway will extend from the present eastern terminus of the turnpike at King-of-Prussia, near Norristown, to the Delaware River, a half mile south of Edgely (see map, page 26 of the January issue). At Edgely, a new bridge will carry the expressway across the Delaware, where it will be connected with a projected six-mile branch of the New Jersey Turnpike, extending west from a point about a mile south of the present Bordentown-Trenton Interchange. Construction is scheduled to start this year.

The bridge is a separate project, which recently received Congressional approval. Construction costs of the bridge will be shared by Pennsylvania and New Jersey.

At Construction Site of New

AEC Savannah River Plant

More than 25,000 construction workers and 6,300 construction equipment units are changing the face of the earth near Ellenton, S.C., where Atomic Energy Commission is building its huge Savannah River Plant on 315-sq mile tract. In photo crane lowers 72-in. concrete pipe into ditch excavated by shovel and clamshell. Ahead of pipelaying, Caterpillar tractor equipped with hydraulic Traxcavator levels ditch bottom, and another tractor unit backfills at rear. Cost of project is estimated at $1,200,000,000. E. I. du Pont de Nemours & Co., Inc., which built atomic furnaces at Hanford, Wash., during World War II, has contract with AEC for design, construction, and operation of new facility. Construction will involve moving almost 6,000 persons from area. Plant proper will be divided into several manufacturing areas, to be connected by 105-mile network of modern highways. Upon completion, area will have at least 250 permanent buildings and employ about 7,200 people. Project was started early in 1951, and construction peak is expected in September 1952. Photo courtesy Caterpillar Tractor Co.

Prestressed Concrete Discussion Highlights ACI Convention

Methods of determining when prestressed concrete will reduce construction costs were discussed at the 48th annual convention of the American Concrete Institute, held in Cincinnati, Ohio, February 26–28. Data on the relative economy of conventional and prestressed reinforced concrete reservoirs were summarized by George C. Ernst, M. ASCE, and C. O. Brunken and A. R. Riveland, Junior Members ASCE, all of the University of Nebraska. Following study of 260 designs, they concluded that reservoirs built of prestressed concrete have a lower first cost than those of conventional reinforced concrete when the unit cost of the prestressed wall in place does not exceed twice that of a conventional wall.

Clair L. Johnson, engineer of Pontiac, Mich., looked at prestressing from the construction angle in a paper entitled "Field Problems in Constructing a Prestressed Concrete Bridge." The design was successfully translated to the finished structure by reduction in the number of specially shaped precast concrete blocks required to permit economical production of standard block machines. Modification of assembling techniques, grouting operations, and the development of reusable joint covers overcame major difficulties on the job.

A group of papers reporting on tests and experience with concrete materials was headed by a discussion of thermal expansion of aggregates and concrete durability by Edwin J. Callan, of the Waterways Experiment Station, Jackson, Miss. Tests on the effects of temperature changes on concrete as influenced by aggregates were described by Stanton Walker, M. ASCE, and Delmar Bloem and W. G. Mullen, Junior Members ASCE, all of the National Sand and Gravel Association, Washington, D.C. C. H. Scholer, M. ASCE, and G. M. Smith, both of Kansas State College, added new data on the use of fly ash in concrete. A 20–30 percent replacement of the cement by fly ash effectively inhibits cement-aggregate reaction in the concrete while imparting better workability and finishing properties, they reported.

ACI awards for the year were presented by Harry F. Thomson, M. ASCE, retiring president of ACI, during the annual dinner meeting. Raymond E. Davis, M. ASCE, director of the Engineering Materials Laboratory at the University of California, received the Henry C. Turner Medal established in 1927 for "notable achievements in or service to the concrete industry." The Alfred E. Lindau Award for "outstanding contributions to reinforced concrete design practice" went to Douglas E. Parsons, M. ASCE, chief of the Building Technology Division of the National Bureau of Standards.

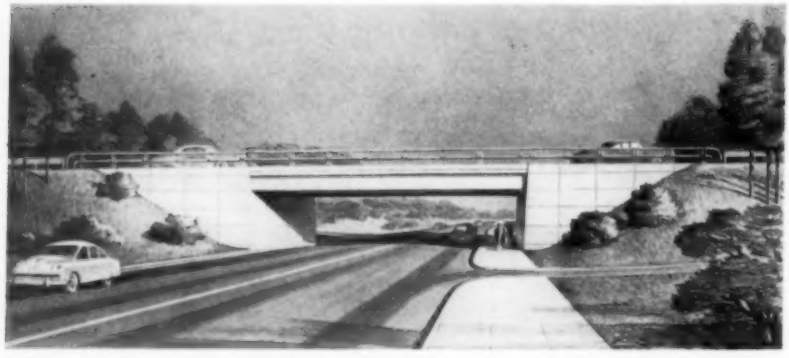
W. J. McCoy, J. M. ASCE, and A. G. Caldwell, director of research and research chemical engineer for the Lehigh Portland Cement Co., received the Wason Medal for "noteworthy research" reported in "New Approach to Inhibiting Alkali-Aggregate Expansion" in the May 1951 ACI Journal. Walter H. Price, M. ASCE, head of the Engineering Laboratories of the U.S. Bureau of Reclamation, Denver, was the recipient of the Wason Medal for "the most meritorious paper" of the volume year, "Factors Influencing Concrete Strength," which appeared in the February 1951 issue of the ACI Journal. The ACI Construction Practice Award went to Otto Saffir, of Vancouver, B.C., for a paper on "Precast Concrete Construction in Canada."

A. T. Goldbeck, M. ASCE, engineering director of the National Crushed Stone Association, Washington, D.C., succeeds Harry F. Thomson, M. ASCE, of Chicago, Ill., as ACI president for the coming year, and C. H. Scholer, M. ASCE, head of the department of applied mechanics at Kansas State College, was elected vice-president for a two-year term.

Texas Air Force Bases to Be Reactivitated

Rehabilitation and expansion of U.S. Air Force bases at Laredo and Harlingen, Tex., incidental to their reactivation, are getting under way with the award of three contracts totaling $4,714,123, according to Col. J. D. Lang, district engineer for the Galveston District of the Corps of Engineers. The largest of these contracts goes to E. E. Cloer, of Fort Worth, Tex., for a low bid of $4,558,695 on general construction at the Harlingen Air Force Base. Other work at the Harlingen Base will be done by the Noser Construction Co., of McAllen, Tex. The Shamrock Engineering and Construction Co., of Oklahoma City, Okla., received a $110,587 contract for the rehabilitation of runways, taxiways, and aprons at the Laredo Base.

Milwaukee Initiates Expressway System



One of the bridges in Milwaukee's projected 44th Street Expressway system, for which ground was broken on March 17, is shown here in artist's rendering. First expressway system in state, four-lane roadway will ultimately extend through center of city and outward in several directions. Federal and state aids are expected to cover about 85 percent of total project cost, which is estimated at $100,000,000 when expressway is completed in 20 to 25 years. Ammann & Whitney, consulting engineers of New York and Milwaukee, have been engaged to prepare preliminary plans on expressway and authorized by city to prepare contract drawings for first three-mile section. Raleigh W. Gamble, M. ASCE, and Walter H. Tacke, A.M. ASCE, are director of expressways and expressway engineer for Milwaukee, and L. P. Larkin is project manager for Ammann & Whitney.

New Jersey Studies New Toll Highway

The feasibility of constructing the Garden State Parkway from Paterson to Cape May County, New Jersey, as a revenue bond toll facility has been reported to the New Jersey State Highway Department by Parsons, Brinckerhoff, Hall & Macdonald, New York City consulting engineers engaged to make a preliminary survey of the project. Estimated cost of the parkway is $268,000,000.

In announcing the results of the engineering survey, State Highway Commissioner Ransford J. Abbott said that other facilities planned by the department include the $90,000,000 Camden area expressways; the $15,000,000 connection between the Pennsylvania and New Jersey turnpikes; a $30,000,000 connection between the New Jersey Turnpike and the New York Thruway; and the proposed $80,000,000 Newark Bay crossing and connection along the Hudson River to the Holland Tunnel, which will be constructed as a spur of the New Jersey Turnpike.

Houston to Have New Freeway

Award of a $1,000,000 contract to the Gulf Bitulithic Co., of Houston, Tex., marks the start of work on a new Houston superhighway project—a six-lane freeway roughly paralleling U.S. Highway 59 and extending from the Humble Highway at Halls Bayou in North Harris County into downtown Houston. To be built by the Texas Highway Department, the proposed freeway will tie in with the city's over-all expressway system, including the Gulf Freeway, still under construction; extension of the Gulf Freeway north to connect with Highway 75; and construction of an east-west Highway 90. The work just initiated will be on service roads—two 30-ft concrete roadways scheduled for completion within eight months.

New York Increases Its Refuse-Disposal Facilities

Following three-year studies by the New York City Department of Sanitation, the Mayor's Committee on the City Incinerator Program has approved long-range plans for construction of incinerators. The studies, initiated as a result of a Board of Estimate mandate in 1948 to incinerate all burnable refuse as soon as incinerators could be built, indicated the need for a daily incinerating capacity of about 13,000 tons. This capacity is based on an estimated peak population of about 8,300,000.

The program calls for construction of eleven new incinerators, modernization and enlargement of five others, and construction of ten marine transfer stations, to be completed by 1960 if city finances permit. The marine transfer stations are necessary adjuncts to disposal of domestic coal ash and incinerator residue by barging to landfill areas. The estimated construction cost of these facilities is $75,000,000.

In implementation of this program, the Betts Avenue (Queens) Incinerator is in operation, the Gansevoort (Manhattan) Plant under contract, and the South Shore (Queens) Plant is now being bid on. Three other incinerators are being designed by the Department of Public Works for a scheduled start of construction in 1953.

C. A. Rogus, M. ASCE, is director of engineering for the Sanitation Department.

Signs of Easing in Steel Situation Seen

An announcement from the Sharon Steel Corp., of Sharon, Pa., that it is shutting down two open-hearth furnaces at its Roemer works "because of poor business conditions" points up recent industrial reports of easing of the steel shortage.

Surpluses in flat rolled steel and wire products are reported by a number of smaller mills, while many of the larger steel mills are able to fill orders for cold rolled sheets, hot and cold rolled strip, terne plate, and electrical sheets without more than a normal active market wait. In addition, many plants are reported to be working on backlogs because the volume of fresh business has not been equal to the present operating rate. The disappearance of the black and gray markets and recent action of the NPA in making more liberal second-quarter allotments of steel are also regarded as highly significant. Despite the fact that the NPA is liberalizing some of its rules and regulations, industry does not expect any large-scale decontrol.

The changing steel picture is attributed primarily to continual operation of the steel-producing facilities of the country at an all-time high of 100 percent of capacity or more; to reductions in civilian demands resulting from NPA regulations; and to the fact that military demands have been less than anticipated. According to other sources, "industry has out-guessed itself by making enough to take care of both defense and civilian needs."

Contract Awarded for Building Cheatham Dam

Construction of Cheatham Dam on the Cumberland River in Tennessee will be started this spring, following award of a $3,086,414 contract by the Army Corps of Engineers to the Contracting Division of the Dravo Corporation, Pittsburgh, Pa. A navigation project, the dam will be located at Mile 148.6 on the Cumberland River, near Ashland City, Tenn., and existing Lock A. A navigation lock is now being built on one shore. Plans are under consideration for the construction of a power station there

Elizabeth River Tunnel Is "Holed Through"

Work on the two-lane tunnel being built under the South Branch of the Elizabeth River between Portsmouth and Norfolk, Va., has progressed to the "holing through" stage. The first direct link between the two cities, the tunnel will tie in with a bridge now under construction over the East Branch of the Elizabeth between Berkley (a suburb of Norfolk) and downtown Norfolk. The total cost of the combined under and over-water expressway, a project of the Elizabeth River Tunnel Commission is estimated at about $23,000,000.

Engineers on the tunnel project are Parsons, Brinckerhoff, Hall and Macdonald, of New York, and the builders are Merritt-Chapman & Scott, of New York. The Portsmouth cut-and-cover section of the tunnel was built by the Sterling Foundation Co., under contract to Merritt-Chapman & Scott. The J. E. Greiner Co., of Baltimore, is the consulting firm on the bridge phases of the project, which is being built by the Tidewater Construction Corp.

Materials Allotted for Commercial Construction

Approval has been given for construction of 645 religious, municipal, and community building projects all over the country, with an estimated total cost of more than $200,000,000, according to an announcement from Henry H. Fowler, Administrator of the National Production Authority. "Materials will be allotted for these projects effective in the third quarter of 1952 and in subsequent quarters where needed to carry each project to completion," he said. "However, the authorizations now being issued will permit the immediate start of preliminary construction such as excavations and footings wherever possible."

Mr. Fowler explained that the Defense Production Administration has made available to the NPA sufficient steel and copper for these projects, which include churches, firehouses, jails, police stations, orphanages and homes for the aged, YMCA's and boys' clubs, community buildings and civic centers.

Cooperation Between Defense and Construction Industry Urged

More effective liaison between the defense mobilization establishment and the construction industry is urged in a series of advisory recommendations adopted at a recent meeting of the Construction Industry Advisory Council of the Chamber of Commerce of the United States in Washington, D.C.

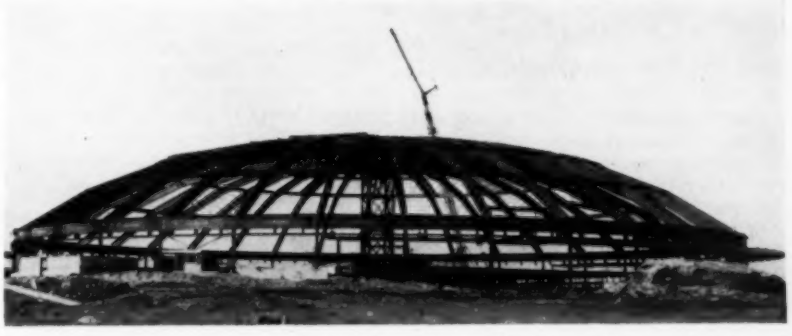
The recommendations, which have been endorsed by the Construction and Civic Development Department Committee, suggest that the "Defense Production Administrator take the further steps, which it is understood he has under consideration, to establish clearly defined responsibility for the handling of construction problems in the Defense Production Administration." As a means to that end, the Council suggests that the DPA examine existing discrepancies between goverment and industry reports on the availability of critical materials, that it promote better screening of quarterly requirements for critical materials for both civilian and military construction, and that it advise on the solution of emergency problems, "including unemployment problems, which are already evident in certain areas."

Ralph Walker has been elected chairman of the Construction Industry Advisory Council for the coming year by the Construction and Civic Development Department Committee. ASCE President Carlton S. Proctor is vice-president of the Council.

Puerto Rico Expands Its Airport Facilities

Construction of Puerto Rico's new $12,000,000 International Airport is being pushed for completion in 1953. Runway is $1\frac{1}{2}$ miles long and 200 ft wide. This and other engineering projects are scheduled for discussion at Inter-American Convention, to be held in San Juan, November 13–15, under sponsorship of Puerto Rico Section.

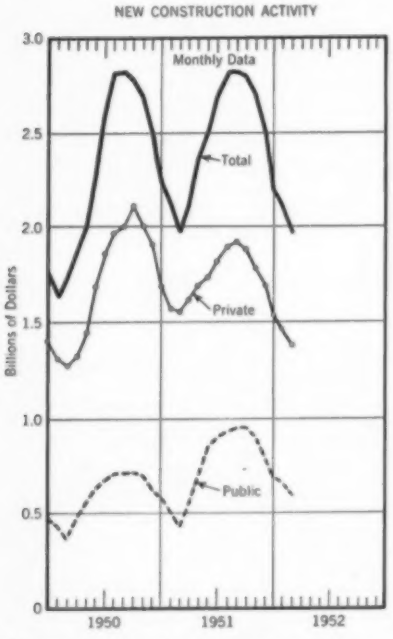
Arc Welding Expedites Steel-Dome Construction



Arc welding solves many complicated problems encountered in building world's largest all-steel, shallow-type dome for newly completed Jordan Marsh store near Boston, permitting erection of steel structure in only twelve weeks. Huge dome, 225 ft in dia, is formed by 36 welded steel ribs, 110 ft long, supported by ring girders, 36 in. deep and weighing 300 psf. Girders for ribs were cut into five sections, beveled at ends, and then welded together with 200-amp welders. To facilitate raising ribs and welding them to 14-ft hub in center, 60-ft tower was erected. Plywood floor piece was fitted between rings to support welders. More than four tons of electrodes were required in construction of dome. Engineers on structural steel design were New York firm of Severud, Elstad & Kruger. Fabrication and erection of steel structure was handled by A. O. Wilson Structural Co., of Cambridge, Mass., and welding was done with General Electric equipment.

Construction Activity in February Shows Decline

A seasonal drop of 7 percent in construction expenditures in February to $2 billion is announced in a joint report of the Building Materials Division of the U.S. Department of Commerce and the Bureau of Labor Statistics of the Department of Labor. All major types of construction shared in the decline except private industrial building, which is heavily influenced by the basic steel and aluminum and aircraft plant programs.



All major types of construction except private industrial building share in February decline of 7 percent over January, as shown in Department of Commerce curves.

The drop in public construction activity was proportionately greater than the drop in private construction activity, as highway work declined seasonally and public industrial and military facility programs failed to expand. Outlays for public construction amounted to $594 million, a decline of 9 percent. On the other hand, private construction expenditures, with a 6 percent drop from $1.5 billion to $1.4 billion, represent a less than seasonal decline, reflecting primarily strength in residential building and the rise in industrial work. A 10 percent increase in housing starts in January buoyed residential building in February, when work went forward on many of the units started earlier.

New construction activities for the first two months of the year were about the same as those for the same period of 1951, with marked changes in the composition of the program, the joint agencies note. The major downswings of 20 percent on private residential work and of 33⅓ percent on commercial work were offset by the huge industrial expansion of 70 percent from relatively high postwar levels and increases in expenditures for military and naval construction. The dollar volume of public housing more than doubled during the year, reflecting activity begun by the spring of 1951 on projects for which planning was started shortly after passage of the Housing Act of 1949.

New York Building Firm Receives Turkish Contract

An $11,000,000 contract has been awarded by the Turkish government to Thompson-Starrett Company, Inc., New York building firm, to head a group of Turkish-German associates on construction of a large dam on the Sakarya River. The dam will be the first major unit in the government's projected $35,000,000 Sariyar Hydroelectric Project designed to expedite the industrialization of northwestern Turkey. It will be financed by the government's Eti Bank, which is utilizing ECA funds for the purpose. About $10,000,000 in steel and other essential materials will be supplied by Turkey.

The straight, gravity-section dam, which will be approximately 350 ft high and 1,000 ft long at the crest, will be the largest in Turkey. About 700,000 cu yd of concrete will be required for its construction, and it will impound a 7,000,000-acre ft reservoir. The Thompson-Starrett Company is shipping specialized American equipment needed to expedite the project, which is in a rugged undeveloped area 175 miles east of Istanbul. Construction started in March and is scheduled for completion in 1954.

Design of the project was handled by the Boston engineering firm of Charles T. Main. Thompson-Starrett has set up a foreign department for the work, under L. P. O'Connor, executive vice-president, and J. G. Tripp, M. ASCE, administrative engineer.

New Aluminum Smelting Line Begins Operation

The first of two new smelting lines being built by the Aluminum Company of America at its Point Comfort (Tex.) Works to meet growing defense needs went into operation on February 28. The new line increases the annual capacity of the plant to about 135,000,000 lb, and constitutes a major step toward alleviating the national aluminum shortage. By the terms of a contract signed last fall by Alcoa and the General Services Administration, the government will have first call for five years on the output of the two new units. The second line is scheduled for completion within three months.

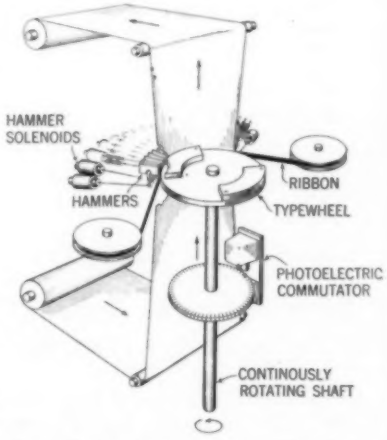
Two new aluminum smelting plants are also under construction by Alcoa. One of these, using hydroelectric power, is being built at Wenatchee, Wash. The other, which employs a lignite-burning steam power plant, is now under construction at Rockdale, Tex. The Point Comfort Works was the first to adopt the radial gas engine for generating power in making aluminum.

"Flying Typewriter" Aids Computation of Data

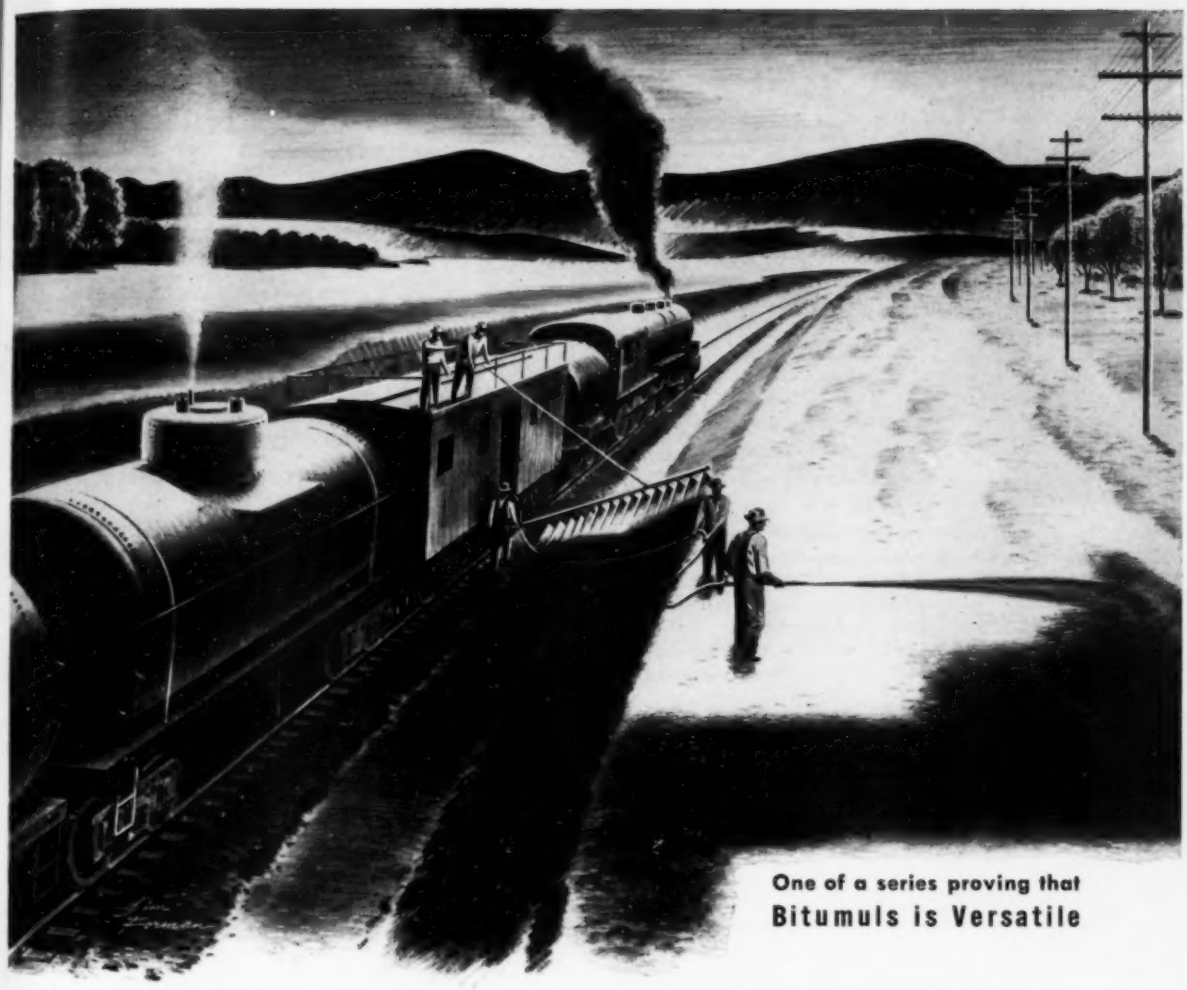
As a long-needed aid in the fields of computing, data handling, and communications, the Potter Instrument Company, Inc., of Great Neck, N.Y., has developed a "Flying Typewriter" that can reproduce 24,000 characters a minute, a line at a time. A total of 47 characters comprising the alphabet, numerals, and other special symbols is employed. The device employs ordinary paper, standard typewriter ribbon, and hard-face type.

The equipment consists essentially of an electronic serial-parallel storage unit, which accepts information in coded-pulse form from an external source such as a computer, magnetic tape, punched cards, and communication lines. Eighty characters corresponding to the characters per line may be serial or parallel fed according to input requirements. Information is alternately stored and extracted in these cycles, completing the cycle once for each line printed.

Wide application is suggested where mass filing of information on business machine cards and magnetic or punched tape calls for convenient and extremely rapid access and translation. Uses include printing magazine address strips, invoices, statistical reports, and notices. The engineering was performed by P. C. Michel, director of research for the Potter Instrument Co.



Alphabet is indicated on typewheel of "Flying Typewriter."



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Diluted BITUMULS® HRM does the job thoroughly, quickly and easily. The material is routed direct to the job area in tank cars—piped to a connecting box car carrying a pump that feeds the Bitumuls direct to the spray equipment—a short spray-bar for shooting the close embankments and a long hose and slotted spray nozzle for areas out to 40 feet or more. The entire unit moves along the track as the job progresses.

Rate of application varies from an economical .3 to .6 gallons per square yard of the 1:1 dilution. Penetration into the dry loose sand is from ½ inch to ¾ inch.

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Bitumuls, versatile enough to hold shifting sands or to bind pavements to withstand the pounding of heaviest highway carriers, is made in many grades. Mixing Grades of Bitumuls are ideal for treating virtually all available aggregates. Quick-Setting Grades of Bitumuls are favored the world over for armorcoat and macadam work. High Viscosity Bitumuls is standard for surface-treating.

Nation-wide, there are Bitumuls Engineers working out of strategically located plants. These men are specialists, qualified by training and varied experience to consult with you, to your advantage, about your paving needs, whether they involve a road, parking area or an airport.

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Chile Harnesses Water Power from Andes

Water power from the Andes is being turned into electricity by Chilean government in huge industrialization program involving construction of six hydroelectric projects. Three plants already completed have capacity of 218,000 kw and three more, with total capacity of 160,800 kw, are under construction. These plants represent an investment of $75,000,000 and 4.5 percent of country's hydroelectric potential. View shows installation of another turbine at 120,000-kw Abanico power station that will serve new industrial city of Concepcion in southern part of state. Wide World Photo.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"I remember," mused the Professor, "the motto of the General Engineer Depot in 1918 was the whimsical, 'It can't be done, but here it is,' expressing the epitome of engineering service in a way that has led to many paraphrases, such as 'Difficult tasks we do today, impossible things tomorrow.' There's a good text for the dog-chase-heifer-around-the-barn problem, isn't it Joe?"

"Maybe," conceded Joe Kerr. "If the heifer started at a velocity of h which doubled at every turn and ran alternately 100 or 200 ft between turns, she would complete the eighth lap around the barn in the time $800(1-4^{-16})/3h$. In the same time the dog runs only 7.5 laps, starting on a 200-ft side at a velocity of d, aggregating $1{,}000(1-4^{-15})/3d$. Equating: $h = 0.8d(1-4^{-16})/(1-4^{-15}) = 0.800\,000\,000\,56d$.

"You asked for the speed of the heifer, and there it is, relatively. No times being given, it is impossible to compute absolute velocity, so maybe I'll do that tomorrow."

"It wasn't me, but Guest Professor Will Metter, who asked. Tell him, Will."

"It's impossible, Noah, but if Cal Klater can't do it today, I will."

"I'll do it," offered Cal, "because, paradoxically, the impossible problem is easier than the difficult one Joe tried. Joe overlooked the significance of the condition 'neither being able to catch the other,' for with his assumption, the dog would run only 37 ft farther before the heifer caught him. If neither can catch the other, $h = 0.8d$ exactly, which means that they finished the eighth lap simultaneously. At this instant the heifer at the NW corner saw the dog at the NE corner because the dog had run 300 ft to the SW corner while light travelled 100 ft to the NE corner. The velocity of light being c, the dog ran 200 ft at $2.5c$ and the last 100 ft at $5c$. Having doubled his speed 31 times, he started at $5c/2^{31}$ and the heifer at $4c/2^{31} = c/2^{29} = 1.8322$ fps."

"That's right," applauded Professor Metter. "The race was off to a slow start, but toward the . . ."

"Wait a minute!" interrupted Ken Bridgewater. "You're talking nonsense. No velocity can exceed that of light!"

"That's matter of viewpoint," explained Professor Neare. "For a mass m travelling at a velocity $v = kc$, the rest mass is $M = m\sqrt{1-k^2}$. Here we have for the dog $k = 5$, so $M = m\sqrt{-24}$, that is, the dog was imaginary, like Harvey, until the seventh round. Thanks, Will, for mystifying Joe again.

"Getting back to earth, Bill Doyle Rhodes, the highway engineer, has proved that, like gravity, traffic varies directly as the product of populations and inversely as the square of the intervening distance up to 40 miles. As proof, he cites Hitherville, Centerville and Yonderville, situated at section corners on a north-south highway and having populations of 1,100, 1,386 and 1,400 respectively, for which he counted 2,191 vehicles leaving Hitherville while 3,091 were leaving Yonderville. How far apart were the towns?"

[Cal Klater was Sauer Doe (Marvin) Larson and Guest Professor Will Metter was Frank A. Randall, Jr. Also acknowledged is a solution long enroute of the November problem from V. D. Phadke of Bombay.]

Housing Starts Rise 13 Percent in February

Homebuilders started 77,000 new permanent non-farm dwelling units in February, an increase of 13 percent (9,000 units) from January, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The rise, which was entirely in private homebuilding, occurred in virtually all sections of the country, "as it became apparent to builders that the materials supply situation was easing." Housing starts made by private builders totaled 74,500 in February, a gain of 15 percent from January and only 3 percent under the February 1951 volume.

A summary of preliminary reports from both urban and rural building-permit officials shows a January-February rise of 25 percent in the number of new units for which building permits were issued, indicating a further strong uptrend of housing starts in March. Especially significant increases in residential permits issued occurred in the Middle Atlantic and North Central States and the Far West. Three-quarters of the reporting cities showed gains, with marked increase in dwelling-unit authorizations in Long Beach, New York, Philadelphia, San Diego, and Washington, D.C.

Borax as Corrosion Inhibitor

Successful use of borax as a corrosion inhibitor in the hydraulics laboratory at Rose Polytechnic Institute is reported by John Newlin, J.M.ASCE, assistant professor of civil engineering. Hydraulics laboratories using a recirculating water system are subject to corrosive action that damages pipes and fittings and causes discoloration of the water, making it difficult to observe flow.

At the suggestion of research engineers of the Commercial Solvents Corp., Terre Haute, Ind., 200 lb of borax were added to the 5,000-gal tank at Rose in 1948. Since then the water has remained clear without further treatment, although addition of some fresh water has been required to replace evaporation losses. Before use of the borax, Mr. Newlin notes, the water would become badly discolored in two or three months after the pipes and tank had been flushed out and the tank refilled.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

A Report to Surveyors

It has been more than a year since the first in this series of "unusual surveying problems and their solutions" appeared in your engineering journals.

Massachusetts survey

The initial page in "The Surveyor's Notebook" showed how a Commonwealth of Massachusetts survey party used captive pilot balloons to get initial lines between stakes separated by heavy timber.

Since then, "The Surveyor's Notebook" has developed into a forum through which veteran field men voice their experiences in solving tough problems and eliminating common surveying hazards—for the benefit of other surveyors and engineers.

A Nebraska deputy county surveyor, for example, has relieved many a headache by explaining how he quickly determined a quarter-section line which was completely blocked by railroad cars. So did Stan Shartle of Danville, Indiana, with his account of leveling over 10 feet of corn.

Joe Thoma

One month, Joe Thoma, the prominent cadastral engineer, gave his remedy for "frozen" tripods; later told of the advantages of the solar transit.

These stories—and letters commenting on them—have come from all over the nation.

Niagara Falls' Corps of Engineers related how it made the first accurate survey of the Niagara River bed with the aid of unusual transit practices. The Chief Locating Engineer of North Carolina has created a great deal of discussion with his plan for improving land survey records.

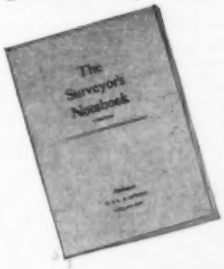
Through "The Surveyor's Notebook", Gordon Ainsworth told how to get an oil pipeline laid in record time by using a few tricks of the trade.

Gordon Ainsworth

Dick Merritt described the unusual problems of surveying in the Arctic, while Jim Caputo showed how aircraft plants use transits. (His story led to the development of a new Gurley instrument for the industry.)

A great many surveyors have written to us saying that the experiences they read about in "The Surveyor's Notebook" have helped them solve their own field problems. And a number of the engineering colleges have requested copies regularly as classroom aids.

Gurley will continue to be notekeeper for the series; welcomes your comments and suggestions—and, of course, your own experiences.



The first year's stories and surveying tips have been gathered together and reprinted in permanent form. Write for your free copy of "The Surveyor's Notebook" *collection.*

When writing for your bound copy of "The Surveyor's Notebook" stories, ask also for Bulletin 50. It gives full details on Gurley instruments.

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DECEASED

William Everett Carigan (A.M. '41) died on January 19, at his home in Liberty, Ky., at the age of 74. After working on the location and construction of railway bridges from 1906 to 1908, he became foreman for the Department of Engineering and Construction, Isthmian Canal Commission for six years. He served at various times as project officer of Casey County, Ky., senior foreman of construction, U.S. Forest Service, at Morehead, Ky., and supervisor of maintenance, Division 6 of the Kentucky State Highway Department. He attended the Agricultural & Mechanical College of Kentucky and Army Service Schools.

John Carson (M. '16) died on February 8 at the age of 89. Beginning in 1891, Mr. Carson was associated for many years with the Duluth Street Railway Co. At various times he was chief engineer in charge of power stations at Duluth and Superior, and supervised roadway engineering, design, and construction of roadway and distribution systems. At his retirement he was chief engineer of the company.

Forrest Ivan Cronkhite (A.M. '43) died at his home in Halethorpe, Md., on February 4. He was 58. He began his career in 1912 as an inspector of municipal works for Chainman, Blake and Woodhull, Newburgh, N.Y., and then worked as a draftsman for Terry & Trench, Inc., and Westinghouse, Church, Kerr and Co. Mr. Cronkhite was a structural designer for DuPont Engineering Co., before he joined the Baltimore & Ohio Railroad Co., where he remained for 20 years. He also served in the Corps of Engineers, and was associated with Willar and Robertson, and Charles R. Scrivener Co., Inc., both of Baltimore.

Harry Gilbert Darwin (F. '87) the last member of the Society to hold the rank of Fellow, died in San Francisco on January 26, at the age of 88. Mr. Darwin was connected with the Safety Car Heating and Lighting Co., New York, N.Y., from 1889 to 1899, as assistant and principal engineer. At various periods later he was associated with the Tenement House Department of the City of New York; the Hackensack Water Co., New Milford, N.J.; the Lewiston Land and Water Co., Lewiston, Idaho; the U.S. Engineer Corp at Berkeley; and the Southern Pacific Railway. For 23 years Mr. Darwin was manager and then administrator of the Indian Cache Ranch, Lewiston, Idaho. He was a graduate of the Columbia University School of Mines.

Charles Francis Dingman (M. '20) died at his home in Palmer, Mass., on March 5, after a brief illness. He was 66. Engineer, architect, author and inventor, Mr. Dingman began his career as secretary and engineer for the Merrick Fireproofing Co., of New York, N.Y. Before entering private practice in 1921, he was associated with the Flynt Building and Construction Co., of Palmer, Mass., for seven years. Mr. Dingman was known for his works on architectural subjects, and as the inventor of such devices as the non-reflecting show window and railway signal service aids.

William Clyde Eddy (A.M. '41) died at his home in Lincoln, Nebr., on December 30, 1951. For 20 years beginning in 1925, Mr. Eddy served the Nebraska State Highway Department in several capacities including rodman, engineer-in-charge of surveys and construction projects, designer, and assistant engineer of maps and plans. His most recent connection was with the firm of Kirkham-Michael, Associates, Omaha, Nebr.

Morris Cable Emanuel (M. '32) retired engineer, died on January 4 at the age of 71. A graduate of Washington University, St. Louis, Mo., Mr. Emanuel was in government service for 22 years. He had been resident engineer, inspector, engineer examiner, and assistant chief of squad for the Public Works Administration, and industrial appraiser for the Missouri branch of the Reconstruction Finance Corporation. During the last war he was head of the Defense Plant Corporation. Earlier in his career he designed a warehouse for the International Shoe Co., while affiliated with the James Black Masonry and Contracting Co., of St. Louis, Mo. He had also been connected with the firms of C. E. Hillyer, Jacksonville, Fla., and William Ittmer, St. Louis, Mo.

Edward Theodore Grandlienard (M. '22) former acting dean of the Towne Scientific School at the University of Pennsylvania, and a member of the faculty for 40 years, died at his home in Drexel Hill, Pa., on November 27, 1951. He was 72. Professor of civil engineering from 1924 to 1944, he first became associated with the school in 1906 when he joined the staff as an instructor. Prior to that, Mr. Grandlienard held positions as assistant supervisor of building and bridges for the New York Central Railroad, and engineer for the New York City Board of Water Supply. He was an alumnus of New York University.

John Owen Miller (M. '26) supervising engineer in charge of the Sacramento River Flood Control project for the California Division of Water Resources, died on March 7. His age was 65. Mr. Miller's engagements included positions as sanitary engineer for the City of Richmond, Calif., engineer in charge of sewer construction at Woodland, Calif., and director of Civil Works Administration, Yolo County, Calif. In 1941 he entered the California Division of Water Resources as an associate hydraulic engineer and advanced to the position he last held. Mr. Miller received his degree in civil engineering from Stanford University.

Charles Augustin Woodley Musson (M. '15) retired engineer of Seattle, Wash., died there on July 19, 1951, at the age of 77, according to information recently received at Society headquarters. Mr. Musson was connected with several railways including the Duluth South Shore and Atlantic Railway; the Chicago, Milwaukee & St. Paul Railway; the Western Pacific Railway; and the Southern Pacific Railroad. He was a veteran of the Spanish-American War.

William Murray Pullar (A.M. '09) of Victoria, Australia, died on December 18, 1951, at the age of 81. Early in his career, he served as assistant surveyor of the City of Footscray. Following that he worked for H. McKenzie & Sons, Contractors, for six years, and later held the position of town surveyor of Essendon. Mr. Pullar also engaged in private practice, remaining active in his profession until two weeks before his death. He was an alumnus of the University of Melbourne.

Robert Colfax Smith (M. '06) of Weslaco Tex., died on December 11, 1951, at the age of 79. After graduating from Purdue University in 1897, Mr. Smith was connected with early foundation studies of the Panama Canal. Upon his return to the United States he worked for the firm of E. C. & R. M. Shankland. He entered private practice in 1921, and joined with Raymond Knapp in 1925 to form a partnership, Smith & Knapp. This was succeeded by the firm, R. C. Smith, with offices at Chicago, Ill. Mr. Smith was a specialist in soil investigations.

Edwin James Snow (A.M. '40) associate engineer with the U.S. Engineer Office, at Rock Island, Ill., died on February 16. Mr. Snow was 45. Before entering the Corps of Engineers, he was connected with the Caterpillar Tractor Co., Peoria, Ill. He graduated from the University of Illinois.

Soren Anton Thorensen (M. '26) retired New York engineer, died at his home there on January 25, at the age 74. An authority on the design and construction of vehicular tunnels, Mr. Thorensen received a degree in electrical engineering from Mittweida College, Saxony, Germany. Arriving in this country in 1903, he was employed briefly by the Minneapolis Steel and Machinery Co., and the Westinghouse Electric and Manufacturing Co. In 1903 he became a draftsman in the office of William Barclay Parsons, New York consultant, advancing to the position of engineer of design by 1920. At the time of his retirement he was a partner in the consulting firm of Parsons, Brinckerhoff, Hall and Macdonald. Mr. Thorensen participated in the design and construction of the Detroit-Windsor Tunnel, Detroit; the Maas River tunnel, Rotterdam; the Antwerp Tunnel, Antwerp; and the Houston Ship Canal.

IN BUILDING SEWERS FOR THE YEAR 2000 TAMPA, FLORIDA CHOOSES *CONCRETE PIPE*

To eliminate dangerous and obnoxious pollution in the Hillsborough River and adjacent bay waters, Tampa, Fla. built an extensive new sewage system. Planned for the future, the system is designed to serve an expanding metropolitan area population that is expected to reach 335,000 by the year 2000, nearly triple Tampa's present population.

The new facilities include intercepting sewers, pumping stations, force mains, lateral sewer extensions, six crossings beneath river and harbor channels, a sewage treatment plant with a 36 mgd primary treatment capacity and a subaqueous outfall.

This huge system was built by several contractors. Greeley and Hansen of Chicago were the engineers for the entire project. Sizes and quantities of concrete pipe used are listed below.

Like Tampa, hundreds of other American cities have selected concrete pipe for dependable, economical sewer service. In many of these cities concrete pipe sewers have rendered ***low-annual-cost*** service for 70, 80, 100 years and more.

Concrete pipe has solved numerous difficult sewer problems because it has (1) the strength to withstand severe impact and to sustain heavy overburdens, (2) the smooth interior surface to resist abrasion and provide maximum hydraulic capacity and (3) the uniformly dense structure and tight joints to insure minimum infiltration and leakage.

Because concrete pipe is moderate in first cost, requires little or no maintenance and lasts so long, it delivers ***low-annual-cost*** sewer service. That is appreciated by civic officials and taxpayers alike.

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CONCRETE PIPE USED IN TAMPA SEWERS

13,500 ft.	60 in.	2,400 ft.	42 in.
16,300 ft.	54 in.	2,800 ft.	36 in.
21,000 ft.	48 in.	13,400 ft.	30 in.
2,900 ft.	27 in.		

CONCRETE PIPE IN SUBAQUEOUS OUTFALL

3,750 ft. 78 in.

CONCRETE PIPE IN RIVER AND CHANNEL CROSSINGS

1,475 ft.	48 in.	320 ft.	36 in.

CONCRETE PIPE IN FORCE MAINS

9,100 ft.	54 in.	250 ft.	48 in.
3,900 ft.	30 in.		

CONCRETE PIPE IN TREATMENT PLANT

1,650 ft.	84 in.	200 ft.	72 in.
215 ft.	54 in.		

48 in. concrete pipe being lowered for channel crossing

54 in. concrete pipe being placed under railroad switch tracks

NEWS OF ENGINEERS

Benjamin C. Allin, head of Allin Associates, Inc., consulting engineers and technical appraisers, of San Francisco, is representative of ASCE on the Building Industry Conference Board of San Francisco, and a member of the Special Projects Committee of the San Francisco Chamber of Commerce which interests itself in engineering phases of problems facing the community.

John C. Arntzen has been elected manager of the Mississippi Valley Structural Steel Co. plant at Melrose Park, Ill. His association with the company began in 1925, and since 1947 he has served in the capacity of chief engineer of the Melrose Park plant.

James E. Clyde has joined the firm of O'Brien & Gere, consulting engineers, Syracuse, N.Y., as an associate member. During the war Mr. Clyde was project engineer in charge of construction of Army and Navy bases in Brazil; executive officer, Army Engineer Corps, connected with the rebuilding of Manila harbor; and area engineer at Yokohama during the occupation of Japan. After his discharge in 1946, Mr. Clyde conducted a general contracting business in Miami, Fla.

James E. Clyde

Robert L. Lowry, consulting hydraulic and civil engineer, specializing in hydrologic and hydraulic engineering, has opened an office in Austin, Tex.

Byron A. Bledsoe, formerly with the Highway Research Board, in Washington, D.C., as engineer of traffic and operations, will become an engineering representative in the Atlanta office of the Universal Concrete Pipe Co. A veteran of World War II, Mr. Bledsoe served as a major in the U.S. Army Corps of Engineers.

H. E. Bovay, Jr., Consulting Engineers, of Houston, Tex., formerly an individual professional engineering practice, has become a partnership consisting of **H. E. Bovay, Jr.; Bennett W. Burns,** formerly assistant chief designer, Humble Oil and Refining Co., Baytown, Tex.; **Charles A. Lawler, J. Wayne Holland** and **Richard B. Robertson,** previously chief engineer and senior engineers with H. E. Bovay, Jr. The firm name and location of offices will remain unchanged.

Gilbert H. Dunstan is now professor of sanitary engineering in charge of sanitary engineering work at the State College of Washington, Pullman, Wash. He has taught at the University of Michigan, Tulane University, the University of Southern California and the University of Alabama.

Anthony E. Steere is retiring after 52 years of engineering service, the last ten years of which were spent with the Washington District, Corps of Engineers, U.S. Army. Mr. Steere's long experience includes work as rodman and inspector for the Metropolitan Water and Sewerage Board, Boston, Mass., engineer and surveyor with the State of New York, design engineer for the New York City Board of Water Supply, and service for the New York and New Jersey Tunnel Administration and the Public Works Administration.

L. Murray Grant has been appointed a member of the Seattle Transit Commission. Mr. Grant recently retired after 20 years as sales engineer for the West Coast Wood Preserving Co., of Seattle, Wash. Previously he had been superintendent of the Seattle Water Department and chairman of the Seattle Board of Public Works. He is a past-president of the Seattle Section.

Hazelet & Erdal, consulting engineers, announce that **F. Spencer Weber** is now an associate attached to their Chicago office. **Robert Kennedy,** principal engineer in the Chicago office, has also been advanced to the status of associate.

Henry W. Hemple, captain, U.S. Coast and Geodetic Survey, recently received the Exceptional Service Gold Medal of the Department of Commerce for leadership in geodetic engineering. Another member of the Survey, **Comdr. Carl Ingman Aslakson,** has been awarded the Exceptional Service Gold Medal for contributing to science and technology in measuring distances by electronic methods.

Leslie G. Holleran, who recently retired from the partnership of Clarke, Rapuano and Holleran, will act as consulting engineer to the partnership of Gilmore D. Clarke and Michael Rapuano, consulting engineers and landscape architects, of New York City.

Leslie J. Hooper, professor of hydraulic engineering at Worcester Polytechnic Institute, Worcester, Mass., has been named director of its Alden hydraulic laboratory at Chaffins. A member of the faculty of the Institute since 1938, Professor Hooper was engaged during the war in secret research for the Navy on the behavior of underwater projectiles.

Raphael G. Kazmann and **Thomas J. Fricke** announce the formation of a partnership under the name, Fricke and Kazmann, Consulting Engineers, in Stuttgart, Ark. They will specialize in the integrated development of surface and ground water supplies.

Walter E. Irving (left) founder of the steel grating industry, and president of the Irving Subway Grating Co., Long Island City, N.Y., and Oakland, Calif., receives framed scroll from Stuart J. Swensson, executive secretary of the Open Steel Flooring Institute. Award was made at testimonial luncheon at the Hotel Roosevelt, New York, in recognition of 50th anniversary of Mr. Irving's company, and honoring him for his pioneering and leadership, and for his devotion during past half century to the industry.

Carl W. Fenske resigned as assistant professor of civil engineering at the University of Texas to accept a position with Greer and McClelland, soils engineers of Houston, who are opening a branch office in New Jersey.

James H. Foster, hydrologist for the U.S. Forest Service at New Orleans, La., is leaving for Europe to accept a position as engineer for the U.S. Air Force.

Mark G. Garver has assumed new duties as traffic engineer and executive secretary to the mayor at Little Rock, Ark. Previously he was resident manager of the J. E. Greiner Co., Houston, Tex., and was connected with traffic surveys for the Arkansas Highway Commission at Pine Bluff and West Memphis.

Edward J. McGrew, Jr., after completing an assignment as assistant chief of staff of the 301st Logistical Command, has resumed his duties as chairman of the New York State Building Code Commission with headquarters in New York City. Called to active duty by the Army in September 1950, Colonel McGrew directed logistical support for Exercise Southern Pine at Fort Bragg, N.C., last summer, and recently completed direction of planning logistical support for Exercise Long Horn to be held at Fort Hood, Tex., this spring.

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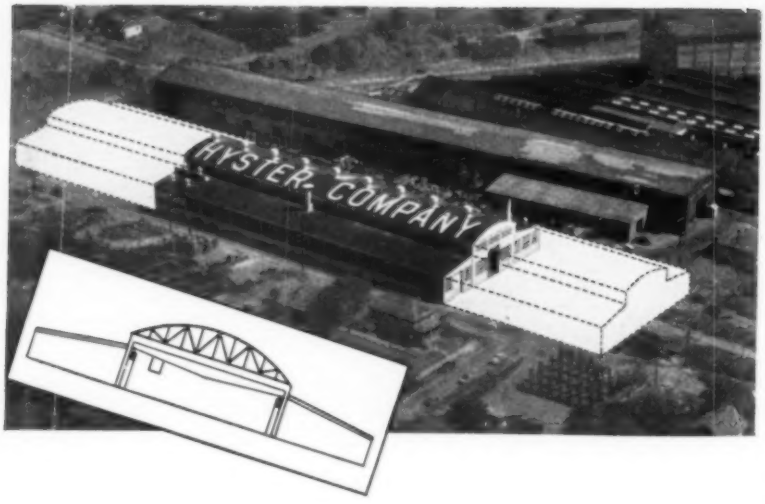

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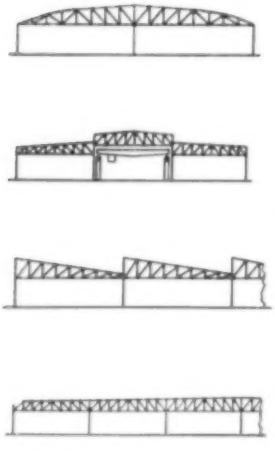

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Carl P. Vetter, Bureau of Reclamation engineer and chief of the Region 3 Office of River Control, Boulder City, Nev., was elected chairman of the U.S. Committee of the International Commission on Large Dams at a recent Washington meeting of the U.S. Executive Committee. Mr. Vetter will take office upon the expiration of the term of **Gail A. Hathaway,** Past-President.

Carl P. Vetter

Fred J. Klaus has retired from city service after 22 years as Sacramento's city engineer. His past experience includes railroad construction work with the Southern Pacific Company, and Santa Fe Railroad, and irrigation work with the Honolulu Plantation Company, and 21 years as chief engineer for the East Bay Water Company, Oakland, Calif. **Edwin A. Fairburn,** assistant city engineer, replaces Mr. Klaus as city engineer. He is a past-president of the Sacramento Section.

Oliver Linton King, township engineer of Abington, Pa., since 1930, is the recipient of the Meritorious Service Medal presented by the Metropolitan Philadelphia Chapter of the American Public Works Association at their annual dinner.

Alexander V. Karpov, consulting engineer of New York City, has left for Karachi, Pakistan, on a United Nations mission. He returned from an engagement in India in 1951.

Alexander Karpov

J. W. Arch Bollong, traffic engineer of the City of Seattle since 1919, was honored at a recent dinner given by the Seattle Safety Council upon his retirement from city service. He will establish offices in Seattle, San Francisco and Los Angeles, as J. W. Arch Bollong and Associates, specializing in traffic and transport consulting engineering, municipal engineering, street lighting, airport lighting and airport control.

Linton E. Grinter and **Ervin G. Bailey** have been appointed members of the Committee on Equipment and Supplies of the Department of Defense Research and Development. Dr. Grinter, research professor of civil engineering and mechanics at the Illinois Institute of Technology, Chicago, has served the committee since May 1949, as chairman of the Panel on Heavy Equipment and Engineering Construction.

Glenn Murphy, professor of theoretical and applied mechanics, has been named to head the department of aeronautical engineering at Iowa State College, succeeding **Carl N. Sanford.** After graduating from the University of Colorado in 1929 he was an instructor in civil engineering at the University of Colorado, and in 1932 joined the Iowa State College staff. Author of numerous textbooks and a recipient of the George Westinghouse Award, he will remain as senior engineer at the Institute for Atomic Research.

Forrest Nagler, manager and chief engineer of Allis-Chalmers atomic power section, is retiring after 33 years. Mr. Nagler entered the firm in 1906, and rose to the position of assistant manager by 1920. In 1929 he resigned to join the engineering organization of A. O. Smith, remaining there until 1932. He became chief engineer of Canadian Allis-Chalmers in 1933 and has been with the company since then in several capacities, including chief mechanical engineer, Engineering Development Division, at Milwaukee.

Roy Edwin Ramseier, sanitary and hydraulic engineer, announces the removal of his office to new quarters at 310 Mercantile Building, 2082 Center Street, Berkeley 4, Calif.

Stewart E. Reimel, brigadier general, U.S. Army (retired) has become an associate of Ten Eyck-Wade-Butler Associates of Washington, D.C. Previously he had been Secretary to the EJC Committee on International Relations in New York City, and consultant on machine tools for the Defense Production Administration in Washington, D.C.

Calvin O. Schofield, formerly engineer-in-charge for the Wichita-Valley Center Flood Control Project for the City of Wichita, Kans., is now associated with Gilboy, O'Malley and Stopper as planning engineer.

Lawrence V. Sheridan, planning consultant, Indianapolis, Ind., announces the formation of a partnership with his son, **Harry C. Sheridan II,** under the firm name, Lawrence V. Sheridan & Son. They will continue activities in all phases of city, county and regional planning, and airport zoning. **Robert W. Sheridan,** another son, will serve as Western representative at Salt Lake City, Utah.

Robert A. Skinner, of the Metropolitan Water District of Southern California, at Los Angeles, has been appointed to the newly created position of assistant chief engineer. Mr. Skinner joined the District in 1933 as an assistant engineer and advanced to assistant chief engineer. His successor as office engineer is **Harris V. Crawshaw,** formerly senior engineer.

Abraham Slavin, consulting engineer and architect of New York City, was recently awarded the Cross of Lorraine in recognition of his scientific contributions to military engineering and construction. Dr. Slavin is an adjunct professor of civil engineering at the Polytechnic Institute of Brooklyn.

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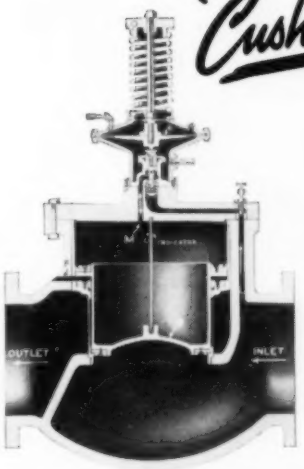

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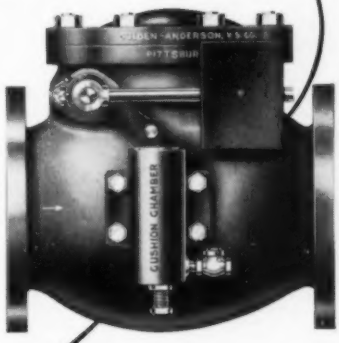

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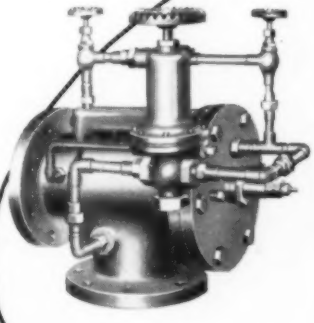

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Mario G. Salvadori, associate professor of civil engineering, Columbia University, has been invited by the Istituto di Calcolo, the Mathematical Laboratory of the Italian National Research Council, to conduct special research on stability of structures in Rome. The Italian Mathematical Laboratory was recently chosen by UNESCO as the seat for the International Mathematical Laboratory. Professor Salvadori, who will be on leave until the fall, has been awarded a grant by the Column Research Council of the Engineering Foundation, a co-sponsor of his research.

J. Ralph Shields, Sacramento city building inspector, retired from city service after 25 years. He was first employed as a structural engineer during construction of a filtration plant. In addition to his duties as building inspector, he has been in charge of all minor construction and maintenance work for the city and has also served intermittently as assistant city engineer.

Fred Van Atta, assistant secretary of the American Concrete Institute since 1946, was named acting secretary-treasurer. He succeeds **Harvey Whipple** who becomes editorial consultant. Mr. Van Atta has been connected with the Michigan Engineering Experiment Station, the U.S. Coast and Geodetic Survey, the Los Angeles District of the Corps of Engineers, the Office of District Engineer at Charleston, S.C., and was responsible for the reconstruction of major bridges near Manila in the Philippines.

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Practical Photogrammetry

The first part of this small volume deals with fundamental theories, equipment, and methods used in both terrestrial and aerial photographic surveying. Part II is devoted to practical applications, with suggestions as to the proper scales to use for different types of projects. An important aspect is the detailed descriptions for the use of a stereoscope and a stereocomparagraph. (The Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. 229 pp., $3.75.)

(*Continued on page 90*)

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3	Highway Embankment on Yielding Subsoil H. L. Lehmann, 40 pages	Soil Mechanics	☐
4	Welded Frame Multi-Story Buildings Boyd S. Myers, 16 pages	Structural	☐
5	Arkansas-White-Red Basins Inter-Agency Committee L. W. Prentiss, 16 pages	Waterways	☐
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CIVIL ENGINEER; J. M. ASCE; 31; married; conducted own surveying business for 3½ years; responsible charge of construction work and field crews. Licensed as land surveyor and U. S. Mineral Surveyor in 12 states. Interested in joining firm in responsible position. C-726-522-A-5-San Francisco.

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SALES ENGINEER; A. M. ASCE; married; C. E. degree; 9 years as sales engineer of steel building materials and construction; 10 years' teaching experience in engineering colleges. Speaks Spanish. Extensive travel in Mexico and Central America. Would be valuable representative in Mexico or Latin America. Adaptable, reliable, energetic; best references. C-728-522-A-12 San Francisco.

CIVIL ENGINEER; A. M. ASCE; M. S. in C. E.; 40; with wide experience in construction of military bases and airfields and supervision of civilian and military organizations. Also experienced in plant maintenance, utility operation, dredging, and flood control. Desires permanent position preferably in Southeast. Available in June. C-729.

CIVIL ENGINEER; J. M. ASCE; 26; single; B. S. in C. E., June 1949. Approximately 3 years' experience in bridge and heavy construction work, including responsible charge of field and office organizing. Desires permanent and responsible position in construction field or job as sales engineer in the South. C-730.

STRUCTURAL ENGINEER-ESTIMATOR; J. M. ASCE; 30; married; B. S. in C. E.; 2 years' experience in design department of government agency; 3 years' experience in design and estimating department of large steel fabricating company. Desires permanent connection with firm in Southeast. Excellent references. C-731.

ENGINEER; J. M. ASCE; 26; graduate student in industrial management. Desires interesting and responsible position in industry, technical or non-technical. C-732.

CIVIL ENGINEER; J. M. ASCE; registered in Idaho; 30; married; 4½ years' experience in general municipal work, including construction of water and sewer lines, street design, street construction and general maintenance. Prefers a position in municipal or public health work. C-733-523-A-1-San Francisco.

GRADUATE TEACHING ASSISTANT; J. M. ASCE; M. S. in Structural Engineering in June 1952; experienced in structural design, field work and research. Desires position as structural designer, preferably with a consulting firm. C-734.

SUPERINTENDENT OF BUILDINGS; A. M. ASCE; 54; C. E. degree; 30 years' supervisory experience in operation, maintenance, design and construction of industrial and institutional buildings as general superintendent, project engineer, chief draftsman, office engineer and squad boss. Available immediately for permanent position anywhere in United States. C-735.

CIVIL ENGINEER; J. M. ASCE; 25; registered; B. S. in C. E., June 1948; 3½ years' varied experience in construction supervision, survey work, design and drafting. Desires permanent position, preferably involving both field and office work. Location preferred, Midwest. C-736-307-Chicago.

CIVIL ENGINEER, M. ASCE; member NSPE; registered Professional Engineer in Ohio, New York, Maryland and Michigan; 20 years' experience in preliminary surveys, including soil surveys and foundation investigations, location, design, construction and maintenance of highways, bridges, airports, dams, industrial and commercial buildings; 6 years' foreign service in England, Africa, Italy, Greece, Ceylon and Turkey. Available May 1st for foreign or domestic. C-737.

STRUCTURAL DESIGNERS

Positions available for qualified men (prefer CE or AE degree) with experience on industrial building, bridges, pressure vessels or steel plate details.

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Positions Available

ENGINEERS. (*a*) Civil or Mining Engineer, 30–40, graduate, with some experience in road building and construction for field work. Knowledge of Spanish essential. Location, Caribbean area. (*b*) Junior Mining, Civil or Mechanical Engineer with mining and construction equipment experience to assist in office engineering covering correspondence, requisitions, specifications, layouts, etc. Salary, $3,600–$4,200 a year. Location, New York, N. Y. Y-6000.

GRADUATE CIVIL ENGINEERS, to 30, to train for sales position with old, well-established construction machinery manufacturer. Territories open in Central and Western states. Splendid opportunity for advancement. Apply by letter giving age, experience, salary expected, business and character references. Headquarters, Ohio. Y-6083.

SANITARY ENGINEER, young, with 3 to 5 years' experience handling waste-disposal problems in industry, or with municipal background. Salary, $4,200–$5,400 a year. Location, Pennsylvania. Y-6099.

SANITARY ENGINEERS, 35–40, to design and draw up sewage systems and treating plants, etc., with knowledge of water producing and distribution. Should have about 10 years' practical experience in addition to a degree in sanitary engineering. Location, Virginia. Y-6120.

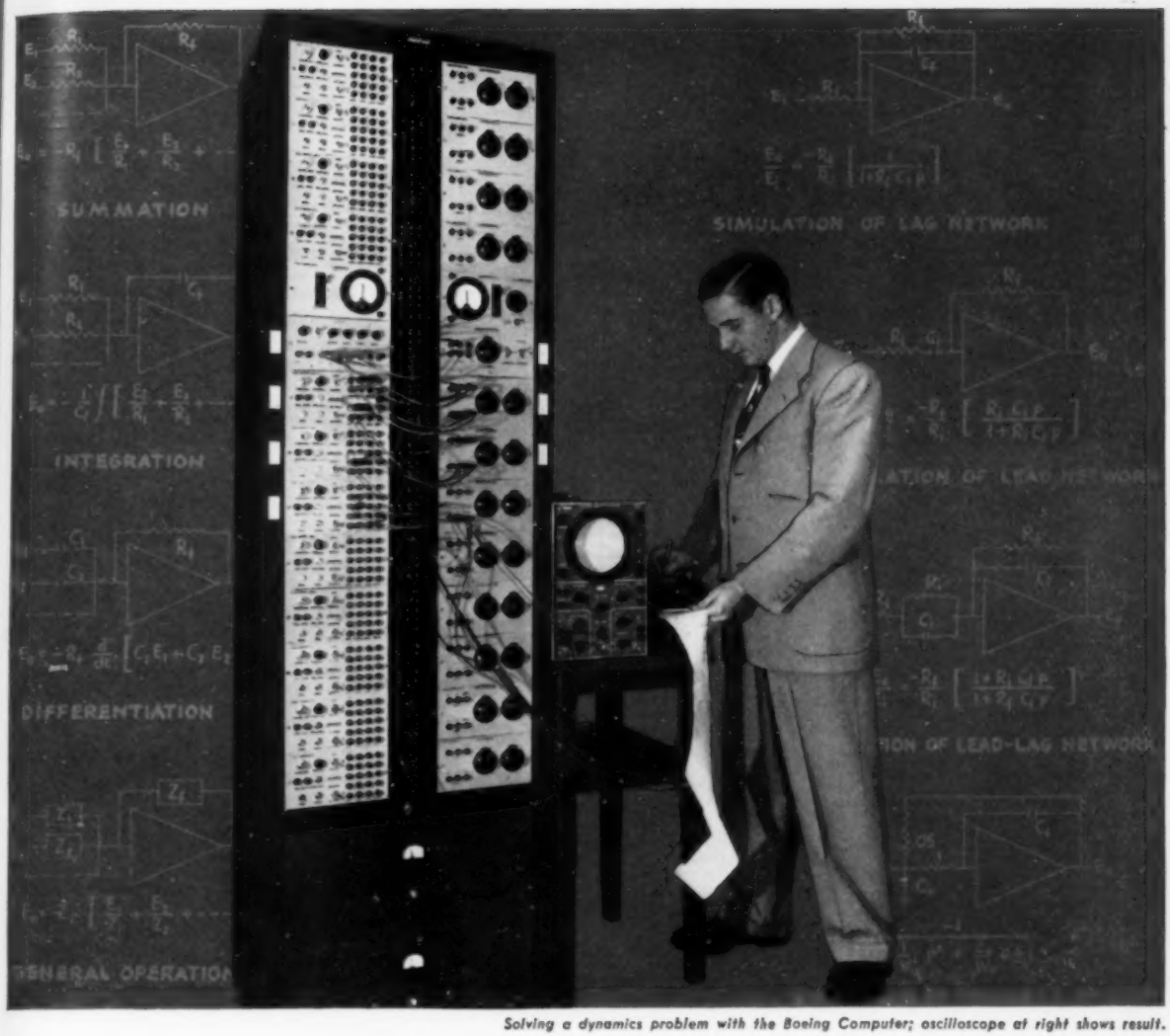
DESIGNER to handle airfield pavements for an extension of present airfield facilities to accommodate jet planes, including widening, lengthening, and strengthening of existing runways and construction of new taxiways and aprons, etc., together with drainage and grading work. Location, Virginia. Y-6137.

ASSISTANT or ASSOCIATE PROFESSOR of CIVIL ENGINEERING, 35–50, with advanced degree and some teaching experience. Should be qualified in fields of soil mechanics and highway engineering. Salary, about $4,000–$4,700 a year. Location, New England. Y-6228 (*b*).

ENGINEERS. (*a*) Senior Structural Designer, civil graduate, with 8 years' experience in structural design. Knowledge of current design developments. Will design foundations, concrete or steel structures for refinery, chemical or power plant equipment. Salary, $5,928–$8,008 a year. (*b*) Structural Designer, civil graduate, with 4 years' experience in civil engineering including 2 years in structural design. Will design foundations, reinforced concrete and steel supporting structures on refinery, chemical plant or power plant. Salary, $7,072 a year. Location, New York, N. Y. Y-6407.

HYDRAULIC AND STRUCTURAL ENGINEER, civil graduate, with at least 8 years' hydroelectric experience to design and supervise design of dams, canals, penstocks and associated hydraulic works. Design foundations for various types of structures, including buildings. Make extensive and important studies involving various hydraulic problems in connection with power system development; prepare estimates and reports, direct preparation of plans and supervise construction operation. Salary, $6,300–$7,200 a year. Location, New England. Y-6445 (*a*).

ASSISTANT PROFESSOR, 30–38, with advanced degree and, preferably, some research experience in civil engineering (with the exception of hydraulics and structural engineering) to teach civil engineering. Rank and salary dependent upon experience. Location, upstate New York. Y-6453.



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BOEING

ENGINEERS. (*a*) Construction Engineers to supervise engineering and coordinate craft work on chemical project. (*b*) Safety Engineers, experienced, to coordinate safety programs, training and inspection. Salaries open. Location, South Carolina. Y-6474.

INSTRUCTOR OR ASSISTANT PROFESSOR to teach surveying and highways and mechanics or hydraulics. Master's degree preferred. Salary to start, $3,800–$4,400 a year. Location, West. Y-6486.

SALES ENGINEER, preferably mechanical or civil graduate, under 40, for company selling pneumatic conveying equipment, automatic scales, storage silos and air compressors to industrial, chemical and cement-using industries. Salary, $4,000–$5,000 a year, depending on experience, plus share in profits on completion of training (about 1 year). Territories, western Pennsylvania, Ohio and West Virginia. Y-6487.

ESTIMATING AND COST CONTROL ENGINEERS, with minimum of 5 to 10 years' construction estimating experience, to be responsible for the preparation of preliminary construction estimates and reviewing of estimates prepared by architects and contractors. Will also be responsible for some cost-control activities and preparation and review of progress estimates during the course of the construction projects. Salaries, $5,000–$8,000 a year. Location, upstate New York. Y-6566.

CIVIL ENGINEER, under 40, with at least 10 years' industrial building construction and plant engineering experience, to supervise plant expansion, equipment installation, etc. Salary open. Location, Liberia. Y-6586.

ENGINEERS. (*a*) Waterworks Engineer, senior, experienced in operation, management and construction of water utility plants, to direct hydraulic studies and design for improvements, as well as direct supervision of operation. (*b*) Junior Engineer, recent civil graduate, interested in waterworks utility plant. Salaries open. Location, New York State. Y-6604.

FIELD INSTALLATION ENGINEER, civil or mechanical training with tunneling and heavy construction experience, for sales, service and installation of tunnel-lining materials. Salary open. Location, Mid-West. Y-6612.

CIVIL ENGINEERS. (*a*) Civil Engineer, graduate, with 3 years' experience in drafting and design of structural details or any equivalent combination of education and experience, with a maximum substitution of 2 years' experience for 2 years of college, unless a registered professional engineer. Salary, $4,576–$5,460 a year. (*b*) Civil Engineer, graduate, with 5 years' experience in design of structures, or certificate as registered engineer and 5 years of such experience. Salary, $4,992–$5,980 a year. Location, Virginia. Y-6629.

CIVIL ENGINEER, graduate, with at least 8 years' design and field experience on waterfront construction, pumphouse, office building, tank foundations, to design bulk terminals with occasional field inspection work. Salary, $6,000–$8,000 a year. Location, New York, N. Y. Y-6647.

CONSTRUCTION SUPERINTENDENT, civil graduate, 35–45, with at least 5 years' field engineering and supervisory building construction experience, to take charge of housing projects, hospitals, etc., for general contractor. Salary, $6,000–$9,000 a year. Location, Panama and Caribbean area. Y-6655.

PROFESSOR OF CIVIL ENGINEERING, graduate, to head civil engineering department. Teaching experience in the field of structures and applied mechanics preferred. Salary, $6,000–$7,500 a year. Location, Virginia. Y-6690 (*a*).

CONSTRUCTION PROJECT ENGINEER, under 35, with degree in architectural or construction engineering, to review plans and specifications for construction projects as well as to recommend architectural styles and types of construction for overseas operations. Will develop recommendations regarding changes in designs or layouts and also will be concerned with material costs, inspection and appraisal, etc. Some traveling to overseas plants for inspection, appraisal, etc. Should have some head office experience with one of the major construction companies. Salary open. Headquarters, Pennsylvania; travel to Canada, Australia, England and Spain. Y-6693.

CIVIL ENGINEERS with B. S. degrees and 6 months to 1½ years' experience in civil engineering. Applicants with M. S. degrees will be allowed full credit for the six months of required experience. Assignments will entail field and office work on new construction and modifications. Salaries, $4,205–$5,060 a year. Location, Connecticut. Y-6701.

MECHANICAL, STRUCTURAL OR CIVIL ENGINEERS, preferably graduates, with 10 years' minimum office experience in designing and preparing working drawings of reinforced concrete and steel-framed industrial buildings and structures. Experience in preparation of cost estimates, construction specifications for industrial buildings, and process equipment installation desirable. Will do general planning of building additions, changes and major repairs for industrial plants. Prepare complete working drawings of industrial buildings and structures of reinforced concrete steel frame or frame construction. General planning and preparation of working drawings of process equipment installations. Preparation of cost estimates and construction specifications. Field supervision and inspection of building construction and equipment installation. Location, state of Washington. Y-6723.

STRUCTURAL STEEL AND CONCRETE DESIGNER, not over 35, preferably with 3 to 5 years' experience in the paper and pulp industry. Salary, $5,000 a year. Location, southern New Jersey. Y-6736.

ASSISTANT SUPERINTENDENT OF PUBLIC WORKS, preferably with N. Y. State Professional Engineering license, for field and office supervision of construction and operation of municipal projects. Salary, $4,600 a year. Location, western New York State. Y-6753.

ENGINEERS. (*a*) Construction Field Engineer, 30–50, with heavy industrial construction experience, to supervise field layout of foundations, reinforcement, structural steel, etc. Salary, $7,800 a year plus bonus. Location, Chile, South America. (*b*) Resident Engineer with at least 20 years' mining experience covering shaft sinking and tunneling. Salary, $12,000–$15,000 a year. Location, Nevada. Y-6755.

CHIEF OF PARTY with topographical, photogrammetric, or geological survey experience for ground layout on serial surveys in various sections of the East. Salary, $4,800–$6,000 a year. Y-6762.

HIGHWAY ENGINEER with experience in design or construction and planning or traffic research, statistics and reports, to do office engineering surveys, tabulations, reports, etc., for technical association. Salary open. Location, Washington, D. C. Y-6765.

FOUNDATION ENGINEER with 10 years' experience designing heavy foundations and bridge piers. Advanced degree in structures desirable. Knowledge of soil mechanics essential. Capable of departmental responsibilities in small organization. Location, East. Y-6776.

CIVIL ENGINEERS experienced in hydrology and hydraulic design, for surveys, studies and design with public authority. Location, Pennsylvania. Y-6780.

EXECUTIVE ARCHITECT, registered graduate, with at least 10 years' industrial, institutional and commercial experience covering design, staff, public relations, contracts, field and sales, to take charge of department, meeting prospects, handling clients, and managing architectural staff for consulting firm. Salary, $8,000–$10,000 a year, plus bonus. Location, Southeast. Y-6783.

CONSTRUCTION ENGINEER, engineering training—mechanical, electrical or civil in construction work, from aides, juniors, up through more experienced grades. To work on construction projects in Kentucky for construction firm. Salary open. Location, Kentucky. T-8661.

SANITARY ENGINEER, civil graduate, to be responsible for design on small to medium-sized sewage-treatment and water-purification plants. Salary to $6,000 a year. Location, Alabama. T-8676.

RESIDENT ENGINEER, graduate civil engineer or architect, to 50. With 10 years' experience in heavy industrial and municipal work. To supervise projects of all types such as roads, sewers, waterworks, industrial building work, etc. Must have good personality and be able to oversee complete project. Location, northern part of country. Salary $10,000 to $12,000 a year. Employer will negotiate the fee. Headquarters, Chicago. R-8680.

SALES ENGINEERS, graduate civil engineer or architect, up to 45, to contact architects, engineers, contractors, and building supply concerns for sales and promotional work for manufacturer of building material products. Conduct meetings with distributors, personal contact and general service work. Territories, Atlanta, Cleveland, New York and Chicago. Travel 50 percent of the time. Salary, $6,000 a year plus expenses. R-8694.

Non-ASCE Meetings

American Wood-Preservers' Association. Headquarters for the 48th annual meeting of the American Wood-Preservers' Association will be the Hotel New Yorker, New York, N.Y., from April 21–23.

Concrete Reinforcing Steel Institute. The annual meeting of the Concrete Reinforcing Steel Institute will be held at The Greenbrier, White Sulphur Springs, W. Va., April 28–May 3.

Chamber of Commerce of the United States. The Mayflower and Statler Hotels, Washington, D.C., will be the scene of the 40th annual meeting of the Chamber of Commerce of the United States, to be held from April 28–30.

Indiana Engineering Exposition. The Indiana Engineering Exposition, sponsored by the Indiana Engineering Council, will take place from May 2–4 at the Purdue University Armory, Lafayette, Ind. Concurrently, Purdue University will celebrate its Gala Week, and hold an Engineering Open House on the campus.

Seventh Purdue Industrial Waste Conference. The Seventh Purdue Industrial Waste Conference will be held in the Purdue Memorial Union Building, Purdue University, Lafayette, Ind., May 7–9.

Conference on Prestressed Concrete. Washington University College, St. Louis, and the Portland Cement Association are sponsoring a conference on prestressed concrete, to be held next month, for architects, contractors and structural engineers in the area. Sessions will be held April 22, 29, and May 6, at 7:45 p.m.

Society of Automotive Engineers. The Society of Automotive Engineers will hold its national aeronautic meeting and aircraft engineering display at the Hotel Statler, New York, N.Y., April 21–24.

Association of Iron and Steel Engineers. The spring conference of the Association of Iron and Steel Engineers convenes at the Netherland-Plaza Hotel in Cincinnati, Ohio, on April 28, for a two-day program.

Third National Surveying-Teachers' Conference. The University of Illinois will be host to the Third National Surveying-Teachers' Conference, at Camp Rabideau, the university's surveying camp in northern Minnesota, August 3–8.

UPADI. A meeting of the UPADI (Union Panamericana de Asociaciones de Ingenieros) will be held in New Orleans, La., August 26–30. The UPADI special committee of United States engineers appointed to work out final plans for the meeting consists of J. M. Todd, chairman; E. A. Pratt, vice-chairman; S. E. Reimel, secretary.

Many Engineers have not yet heard the good news:

...LOCKHEED IN CALIFORNIA HAS RAISED ENGINEERS' SALARIES

Lockheed Aircraft Corporation has raised engineers' salaries recently, in recognition of the importance and excellence of their work on both military and commercial aircraft.

The substantial increases make Lockheed engineers among the highest paid in the aircraft industry.

Engineers who join the Lockheed staff receive the benefits of these pay boosts.

In addition to increased salaries, Lockheed also offers engineers:

1. A "bonus" every day in better living—just because you live in Southern California, in an area where the climate is beyond compare.

2. A future that offers both security and advancement, helping create planes for defense, planes for the world's airlines in Lockheed's long-range development program.

3. Better *personal* working conditions among men who have built a reputation for leadership in aviation.

To forward-looking Civil Engineers:

Become an Aircraft Engineer at Lockheed's Expense

The step up to Aircraft Engineering isn't as steep as you might expect. Aircraft experience isn't necessary. Lockheed takes your knowledge of engineering principles, your experience in other engineering fields, your aptitude, and adapts them to aircraft work. You learn to work with closer tolerances, you become more weight conscious. What's more, Lockheed trains you *at full pay*. You learn by doing—in Lockheed's on-the-job-training program. When necessary, you attend Lockheed classes. It depends on your background and the job you are assigned. But always, you learn at full pay.

To Engineers with Families:

Housing conditions are excellent in the Los Angeles area. More than 40,000 rental units are available in the Los Angeles area. Huge tracts for home ownership are under construction now. Thousands of homes have been built since the last war. Lockheed counselors help you get settled.

Lockheed also offers these extra benefits:

Generous Travel allowances • Outstanding Retirement Plan • Vacations with pay • Low cost group life, health, accident insurance • Sick Leave with pay • Credit Union, for savings and low-cost financing • Employees' Recreation Clubs • Regular performance reviews, to give you every opportunity for promotion • On-the-job training or special courses of instruction when needed.

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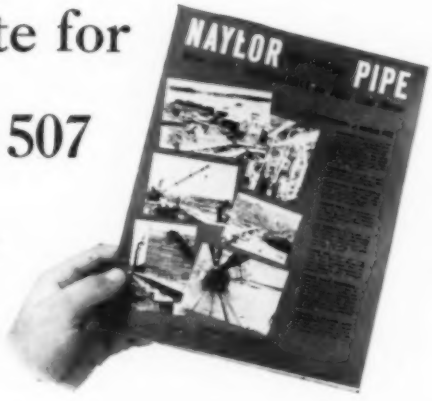

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Recent Books

(*Continued from page 84*)

ACI Standards—1951

Current A.C.I. standards as reprinted from Journal of the American Concrete Institute include the following: Building code requirements; specifications for concrete pavements and cast stone; recommended practices for the application of mortar and portland cement paint for winter concreting, silo construction, concrete mix design, concrete mixing and placing, and the use of metal supports for reinforcement. Minimum standard requirements for precast concrete floor units are given. Because of its large format the "Manual of standard practice for detailing reinforced concrete structures" is available only as a special publication. (American Concrete Institute, Detroit, Mich., 1951. $3.00—$1.75 to A.C.I. members.)

Bauten aus Beton- und Stahlbeton-Fertigteilen

A detailed treatment, by S. Kiehne and revised by P. Ponatz, of various types of prefabricated concrete and reinforced-concrete structural units ranging from blocks to roof-trusses. The materials utilized are discussed and the construction or assembly methods are classified and described. Buildings are dealt with most extensively but other types of construction are also considered—mine structures, tunnels, bridges, etc. The final section is devoted to the location, arrangement, and equipment of plants for the manufacture of prefrabricated units. (Springer-Verlag, Berlin, Göttingen, Heidelberg, 1951. 357 pages, *D.M.* 31.50.)

(The) Fundamental Principles of Reinforced Concrete Design

Intended to bridge the gap between textbooks on "theory of structures" and design manuals, this book, by W. T. Marshall, relates actual design practice to the fundamental principles of reinforced concrete theory. Examples are worked out in detail, including prestressed concrete elements and covering plastic theories of design. (Blackie and Son Ltd., London and Glasgow, 1951. 176 pp., Sh. 20/-.)

Proceedings of the Third Annual Industrial Engineering Institute

The seventeen papers included in this publication deal with the following topics: work-factor aspects; methods-time measurement; production estimating; time study rating; operational studies; personnel handling; and union problems in setting production standards. The presentation of some of the papers was accompanied by the showing of films. These films have been made available for purchase. (Published by the University of California, Berkeley 4, Calif. 82 pp., apply.)

Welding Principles for Engineers

In *Welding Principles for Engineers*, Prof. J. L. Morris has presented the basic principles of the science of welding in a form suitable for the instruction of professional engineering schools rather than trade schools. It covers the field broadly and illustrates the principles with appropriate practical problems. Chapters on stress and distortion, on design problems relating to welding, and on factors affecting economy are included. (Prentice-Hall, Inc., New York, N.Y., 1952. $7.)

Finite Deformation of an Elastic Solid

The essential feature of this book by Francis D. Murnaghan is the consideration of squares and higher powers of the strain components in the theory of elasticity. This treatment permits the application of the theory to larger deformations and stresses than those allowed by the classical theory. Matrices are used methodically with a preliminary explanation in the first chapter. Topics of special interest are the importance of non-isotropic media and the problem of deformation under extreme pressures. (John Wiley and Sons, Inc., New York, N.Y., 140 pp., $4.)

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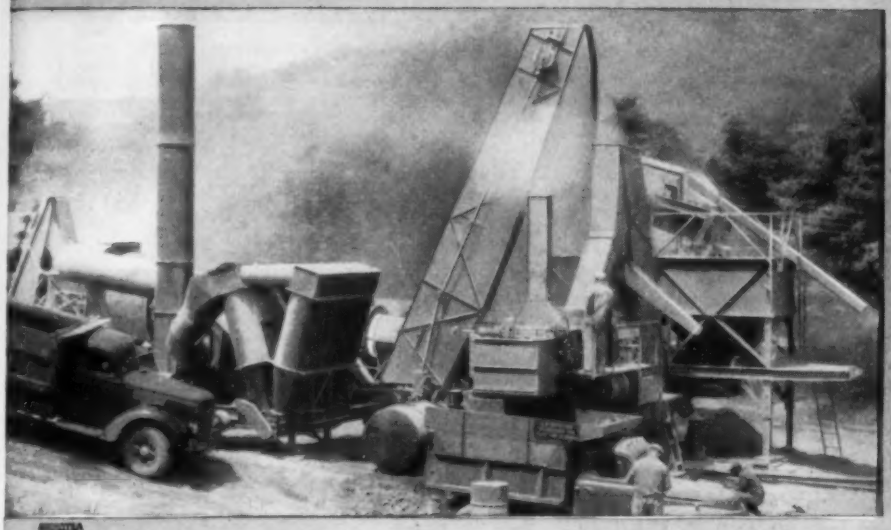

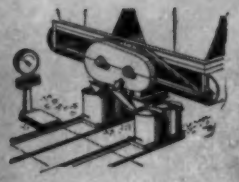

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GRADATION UNIT SCREEN and bin design permit separation of aggregate into 2, 3 or 4 fractions to meet *any* specifications.

DUST COLLECTOR for use with any plant when it is necessary to conserve desirable fines in aggregate.

BY-PASS GATE for convenient calibration, inspection and sampling. Aggregate in each bin may be individually sampled without interference to plant operation and production.

BY-PASS GATE ahead of pug mill. Composite aggregate sample may be obtained for convenient testing without interfering with operation and production.

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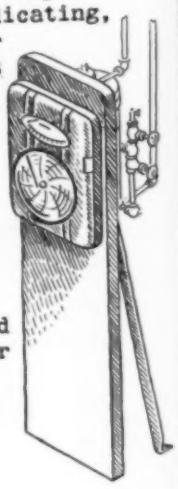
Feeding Chemicals in Proportion To The Raw Water Flow

Problem: to feed ferric sulphate to raw water entering the filter plant generally in proportion to the quantity of water flowing. The most logical way to do this was to use a volumetric dry chemical feeder, actuated by electrical means from a venturi meter installed in the influent line.

Solution: 36" x 18" cast iron Simplex venturi tube and a Simplex indicating, recording and totalizing meter were installed. The meter was equipped with a contactor device operating in conjunction with the totalizing element of the instrument and also operating the mechanism of the remote feeder by electric transmission.



Result: an accurate record of influent flow was made, and coagulant was fed to raw water in the correct dosage. Here again the adaptability of the Simplex venturi meter to measurement and control has been demonstrated.

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Advanced Engineering Mathematics

This comprehensive work by C. R. Wylie, Jr. covers ordinary and partial differential equations, Fourier series and the Fourier integral, operational calculus developed through the use of the Laplace transform, Bessel functions, theory of functions of a complex variable, vector analysis, and such techniques of advanced numerical computation as the numerical solution of equations and systems of equations, finite differences, harmonic analysis, least squares, and the method of Stodola. Applications are illustrated in the fields of mechanical and electrical circuits, vibration, fluid flow, etc. (McGraw-Hill, New York, N.Y., 1951. 640 pp., $7.50.)

Corrosion. Causes and Prevention

Extensive revision and additions have been made in this 3rd edition of *Corrosion, Causes and Prevention* by Frank M. Speller. Technical detail has been restricted to that necessary for a sound understanding of the many factors involved in corrosion and the principles of corrosion prevention, mainly with relation to ferrous metals. Many references are included as footnotes but the general bibliography has been omitted from this edition. (McGraw-Hill, New York, N.Y., 1951. 686 pp., $10.)

Steel Construction

Now in its fifth edition, this valuable manual published by AISC contains two important changes. In Part IV, the specifications for the design, fabrication and erection of structural steel for buildings (riveted, bolted and arc welded construction) and the code of standard practice for steel buildings and bridges, have both been substantially revised for texts from former editions. Tables of available rolled shapes have been radically revised to conform to the lists agreed upon by industry since the close of the war and contained in "Simplified Practice Recommendation R-216-46" of the U.S. Department of Commerce, National Bureau of Standards, issued February 1946. (American Institute of Steel Construction, New York, N.Y., 1951. 422 pp., $3.09.)

Studies in Large Plastic Flow and Fracture With Special Emphasis on the Effects of Hydrostatic Pressure

During the many years that the author, P. W. Bridgman, has studied the effect of high hydrostatic pressure on the properties of matter, he has observed many fractures under unusual conditions. In this book he presents a coordinated exposition of these observations and the studies he has made on them. Tension, compression, torsion, and shearing stress tests are reported. Materials studied include steel, aluminum, copper, brass, bronze, glass, beryllium, soapstone, marble and others. One chapter deals with plastic flow and fracture after prestraining. (McGraw-Hill Book Co., New York, 1952. 362 pp., $8.)

Applications for Admission to ASCE, February 16–March 8

Applying for Member

MOHAMMED ATHAR, Hyderabad-Deccan, India.
CLIFTON CECIL COBB, Birmingham, Ala.
HENRY LAWTON CONGER, Casablanca, French Morocco.
FRANCISCO JACINTO SARMENTO, CORREIA DE ARAUJO, Porto, Portugal.
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1 ADJUSTABLE STEEL SHORES

Acrow, Inc.—A 4-page booklet gives detailed information and shows typical applications of patented adjustable steel shores. Detailed information as to sizes available, recommended working loads, and special head fittings is also supplied.

2 AERIAL MAPPING

Aero Service Corporation—offers catalogs or literature covering its varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

3 AERIAL PHOTOGRAPHIC SERVICES

Abrams Aerial Survey Corporation and Abrams Instrument Corporation—describe their services in catalogs covering the preparation of aerial surveys and the production of the specialized instruments used in the evaluation and utilization of aerial photographs. The uses and economies of aerial surveys are presented and complete services in aerial photography and aerial mapping are offered, including the production of controlled mosaics and of topographic maps. A complete range of instruments covering all phases of aerial photographic interpretation is shown in a convenient letter size catalog. Instruments shown include stereoscopes of several types, contour finders, height finder, vertical and oblique sketchmasters, and mechanical triangulators.

4 AIR AND GAS DIFFUSER

Infilco Inc.—Bulletin 6530 on a new type of equipment for fine diffusion of air or other gas into a liquid in sewage and industrial waste treatment, water conditioning, biological manufacturing processes and absorption processes, is offered. An important feature is the ease with which the flexible fabric diffusing elements can be cleaned and their permeability maintained.

5 AIR-ENTRAINED CONCRETE

Lone Star Cement Corp.—A 36-page booklet, illustrated with 11 graphs and tables and 86 photographs, contains technical and practical information as to desirable air content, increased durability and resistance to frost action, improved workability, reduced bleeding and easier finishing of concretes made with Lone Star air-entraining Portland cement and "Incor" air-entraining high early strength Portland cement. Of special value is definitive information for use in designing air-entrained concrete mixes.

6 ALL STEEL FORMS

The Irvington Form & Tank Corp.—A 40-page manual describes the method of using Atlas all steel speed forms and illustrates the many different types of concrete structures on which the form has been used. The manual also contains complete details describing the various sizes of form and accessories.

7 AUTOMATIC BACKWASH FILTER

Hardinge Company, Inc.—A 12-page bulletin 46-A, lists the advantages of automatic backwash rapid sand filter, and includes sectional drawings, charts, diagrams. Water supply, paper mill, and sewage and industrial waste applications are shown.

8 BITUMULS PLAYGROUNDS

American Bitumuls & Asphalt Company—An illustrated booklet describes bitumuls surfacing products for playgrounds, tennis courts, walks and driveways. Basic specifications are given with comparative illustrations. Products are applied cold.

9 BLUEPRINT MARKING PENCIL

American Lead Pencil Co.—New brilliant colors in the Venus color pencil line for marking on blue or white prints. 54% stronger—sharpens to a sharp needle point and holds it. 27% greater markability—brilliant clear marking—waterproof, too!

10 BOILERS AND STOKERS

James Leffel & Company—28-page Bulletin No. 236 covers the complete line of Leffel scotch type boilers which are either oil, gas or coal fired. It also includes underfeed stokers in a wide range of sizes. Photographs and cutaway drawings show boiler design and application details. Test results, case studies and specification data are included. A complete description is also given on the automatic underfeed stoker, which is suitable for other makes of scotch type boilers.

11 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" catalog B-3 explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

12 BREAK-RESISTANT MASONRY BLADES

Clipper Manufacturing Company—For information on a masonry cutting blade that is virtually unbreakable write for circular No. 147. Intricate cuts and grooving are now possible with this glass fiber cloth blade, plus 50 to 100 percent longer blade life.

13 BRONZE CASTING ALLOYS

American Manganese Bronze Co.—A 50-page edition of the "Reference Book on Bronze Casting Alloys" gives general information on composition characteristics, and applications of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

14 BUSINESS & TECHNICAL GUIDE

McGraw-Hill Book Co.—offers a new 1952 guide to practical, expert information on many business and technical subjects. The catalog contains clear, concise descriptions of more than 2,000 books written by leaders of business, industry and research. In it there is an up-to-date listing of books that give the facts—experience—data—needed in solving your particular problems.

15 CAST IRON PIPE

Warren Foundry & Pipe Corp.—has a general catalog showing weights, dimensions, description, etc., of bell and spigot, flange, flexible joint and mechanical joint cast iron pipe and fittings together with standard specifications for same.

There are 168 Digest items on pages numbered 94 to 114. Read all items for the literature of interest to you.

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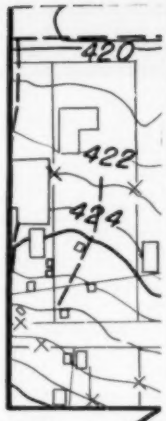

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CATALOG DIGESTS

16 CAST IRON PIPE CALCULATOR

R. D. Wood Co.—offers a calculator for determining class, weight and dimensions of bell and spigot pipe in sizes from 3 in. to 30 in. and for working pressures 50 lbs. to 250 lbs.

17 CATALYZER

A. B. Hydrocarbon Systems—A bulletin on an apparatus named Solatone is offered. The most recent discovery of Solatone has brought to the internal combustion engine industry, a remarkable new aid in in the lubrication of thermal engines which eliminates carbon deposits, gums and sludges caused by the final transformation or destruction of the petroleum products in the combustion chamber.

18 CEMENT

Trinity Portland Cement, Division of General Portland Cement Company—presents photographs and data showing the use of architectural concrete units on the Prudential Building, Los Angeles. The photos and pen sketches give a pictorial description of various steps of installing these units.

19 CEMENT GUN

Cement Gun Company, Inc.—Of considerable interest to the engineering profession is a 65-page booklet, designated as Bulletin 2400, describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

20 CEMENT MORTAR LINING

Warren Foundry & Pipe Corp.—offers A.S.A. Standard Specification A 21.4.–1939 for cement mortar lining for cast iron pipe and fittings.

21 CENTRIFUGAL PIPE

The American Cast Iron Pipe Company—manufactures Mono-Cast centrifugal pipe in diameters 3 in. to 48 in., inclusive, with joints for every service condition, including American Double-X, molox ball joint, bell and spigot, roll-on joint, threaded and coupled well casing, flanged pipe with screwed-on flanges and armored pipe. Write for literature stating the kind of joint in which you are interested.

22 CENTRIFUGAL PUMPS

Byron Jackson Co.—offers a bulletin containing full details of the Pneumatic Sponge, an air-driven, centrifugal pump for a wide range of applications. Especially designed for use in construction, salvage or similar jobs where the pumped fluid contains a heavy percentage of solids. Pump construction, capacities and specifications are shown. Another informative bulletin has 12 pages and describes BJ Vertical Circulating Pump advantages. Designed for continuous service, such as dewatering, circulating and drainage pumping, these pumps are fully explained with cut-away drawings and photographs. Capacities, dimensions and installation data are also shown.

23 CHEM-O-FEEDERS

%Proportioneers, Inc.%—Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

24 CHURCH CONSTRUCTION

Timber Structures, Inc.—has a catalog which features economy and beauty of church construction with glued laminated timbers. It contains actual photographs in color and black and white of some of the world's most distinctive churches, and includes practical adaptations of glulam arches and decorative super structures. Tabular data includes information on typical purlin sizes, together with typical sizes of glulam beams and haunch sections of Tudor arches.

25 CLARIFIERS

Hardinge Company, Inc.—A 12-page equipment bulletin, gives a complete description and specifications of the beam-type, circular clarifiers; center-column type, circular clarifiers; and rectangular clarifiers for skimming and sludge collecting. It also describes Hardinge digesters, automatic backwash sand filters, flocculating equipment and Ruggles-Coles rotary dryers. Bulletin 35-C covers stream pollution problems encountered by practically all industries which have a waste disposal problem.

26 CONCRETE AIRPORT PAVEMENT

Portland Cement Assoc.—The 46-page booklet is a manual of new design procedures for runways, aprons and taxiways made necessary by heavier wheel loads and multiple wheel landing gears. It contains simplified design charts for determining slab thickness under different conditions of service, jointing practices, use of reinforcing steel, subgrade preparation and construction procedures for concrete resurfacing.

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27 CONCRETE CONSTRUCTION

Sika Chemical Corporation—A 12-page illustrated book lists detailed information and performance data on Plastiment, the concrete retarding densifier (retards set, densifies mix) designed for use with all types of aggregates and all methods of mixing and placing. It discusses 14 additional materials of construction, engineered for coating, sealing, hardening and repair work on concrete and masonry, and is complete with product descriptions and composition, specific uses, contributing properties and architect's specifications.

28 CONCRETE FORM-TIES

Richmond Screw Anchor Co., Inc.—Comprised of 8 sections devoted to the various styles, types and sizes of form-tying devices and other accessories for concrete construction, the new catalog is an extremely informative, fact-packed manual which shows by charts, pictures and word descriptions the proper selection and use of each of the items in the Richmond line. Also, the section on screed supports has been revised and brought up to date as of October 1950. The catalog covers snap-tys, tyscrus, hanging systems, screw anchors and bolts, inserts and other devices.

29 CONCRETE PAVEMENT DESIGN

Portland Cement Association—An 86-page edition simplifies and expedites design procedure for roads and streets carrying all classes of traffic. Eighteen pavement design charts have been reduced to four covering a somewhat wider range. This manual for the practicing engineer includes design charts for tiebars and dowels, an expanded section on subbases, two pages of joint details and a simplified procedure for determination of "controlling wheel load."

30 CONCRETE PIPE

Lock Joint Pipe Co.—A pamphlet describes all past installations of Lock Joint pressure pipe and is illustrated with cross-section cuts of joints and pipe design. Another illustrated pamphlet describes the manufacture and technical design of prestressed concrete cylinder pipe.

31 CONCRETE PIPE

Price Brothers Company—"Only Concrete Pressure Pipe meets the Big Three Requirements for Water Line Construction" is the title of a three-piece set of literature on prestressed concrete steel-cylinder pipe. It explains how concrete pipe has long life, sustained capacity and the great strength necessary for ideal water supply lines.

32 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

33 CONCRETE PIPE HANDBOOK

American Concrete Pipe Assoc.—A handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.T.M. and AASHO specifications. Price $4.00.

N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.

34 CONCRETE REINFORCING DESIGN HANDBOOK

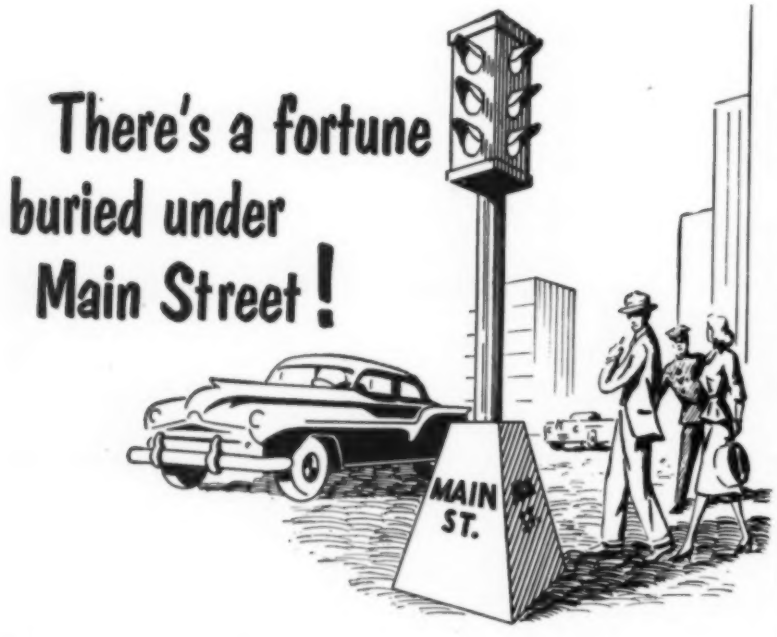
Concrete Reinforcing Steel Institute—"CRSI Design Handbook" reduces complex problems of stress and load to simple table references. With this book, designers can now obtain predesigned reinforced concrete members without time-consuming calculations. Given load and span data, the engineer can quickly get the size of a concrete member and complete reinforcing bar data, by just reading the answers directly. Covers floor systems, columns, footings, retaining walls, and a wealth of miscellaneous information. Latest building codes are followed throughout. Price is $5.00.

N. B. There is a charge for this book. Make checks payable to the Concrete Reinforcing Steel Institute.

35 CONCRETE SAWS

Clipper Manufacturing Company—Circular No. 1-C gives full information on five models of concrete saws, gasoline and electric powered. Shows solution to all types of concrete cutting: patches, utility trenches, contraction joints, building floors, walks, drives, and even large concrete pipe and curbs.

Turn to page 94 and order your literature.



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36 CONSTRUCTION COST CONTROL

American Society of Civil Engineers—You can save on construction costs with the help of this comprehensive 97-page handbook which provides answers to construction accounting and cost control problems common to all. Authored by experts with many years of field experience, it covers the complete cycle of estimating, accounting, distributing and analyzing of all operational and overhead costs. $4.00 to members, $5.00 to nonmembers, postpaid.

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37 CONTROLLERS AND LAYOUTS

Simplex Valve & Meter Company—Bulletin 250 gives dimensional data on horizontal and vertical type controllers and clearance layouts for these units when using different type close-off arrangements. Type "S" rate controller for use in effluent lines from rapid sand type filters. This bulletin is of essential interest to the filter plant designing engineer.

38 CRAWLER TRACTORS

International Harvester Co.—A 12-page road building brochure, Form CR-96-B, has just been published. The full line of International crawler tractors is shown in 34 on-the-job scenes handling every phase of dirt moving from pioneering to final grading.

39 CRUSHING AND SCREENING PLANTS

Austin-Western Company—Bulletin No. 1999 describes the latest Austin-Western two-unit and three-unit portable crushing and screening plants which have been developed for either pit or quarry use. How these plants are capable of delivering high tonnages of aggregate in accurately controlled sizes; and how the three units (primary breaker, primary and secondary) may be used separately or in combination, as desired, providing flexibility of operation, is contained in the bulletin.

40 CUSHIONED VALVES

Golden Anderson Valve Specialty Company—An 8-page bulletin describing the features of the company's cushioned automatic water and steam valves is available. Featured in this catalog are float valves, altitude valves, check valves, solenid-operated valves, reducing valves, relief valves and non-return valves—valves used by municipalities and industries everywhere.

41 DIAMOND AND SHOT CORE DRILLS

Acker Drill Company, Inc.—Bulletin No. 33 describes a complete line of lightweight portable core drills and soil sampling equipment. It also describes both diamond and shot type drill rigs, their uses and applications.

42 DIESEL ENGINES

Caterpillar Tractor Co.—The 16-page illustrated booklet entitled, "Caterpillar Diesel Engines" contains first hand, complete information on the latest and most powerful diesel engines, models D397, D386, D375 and the D364. The booklet covers the outstanding advantages and qualities in the company's diesel engines and is complete with specification and performance charts.

43 DOORS

The Kinnear Manufacturing Co.—The new 1952 catalog and data book discusses fully and illustrates the advantages, the economy, the construction features, and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 72, it gives information on installation clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

44 DRAINAGE PRODUCTS

Republic Steel Corp.—A 20-page booklet, "Engineering Data—Toncan Iron Sectional Plate Pipe, Arch-Pipe, Arches" gives necessary information on design, size, weight, etc., of shop fabricated structures for re-assembly on site. Valuable for engineers, contractors, draftsmen, and purchasing agents.

45 DRAIN PIPE

Walker Cement Products Company—has a bulletin on Poroswall rapid drain pipe which is recommended for use in solving the drainage problems of airports, highways and roads, retaining walls, flood control projects, etc. It lists advantages, shows a typical cross section and includes specifications.

46 DRAWING PENCILS

The Eagle Pencil Company—offers free, a Turquoise drawing pencil with new 100 percent electronic graphite lead. Please specify degree of hardness desired.

47 DRILLING OPERATIONS AND EQUIPMENT

The Salem Tool Company—Brief, detailed descriptions of drilling operations and equipment have been prepared for easy reference in two colorful folders. The literature catalogs many different types of McCarthy drills designed for blast hole drilling, earth moving, tunneling and strip mine coal recovery work. Material includes: installation photographs, case history figures, specifications and a listing of available augers, cutting heads, bits and other drilling accessories.

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WRITE FOR ILLUSTRATED CATALOG

HERB J. HAWTHORNE INC. 2607

P. O. BOX 7366, HOUSTON 8, TEXAS

48 DUAL FUEL DIESEL ENGINES

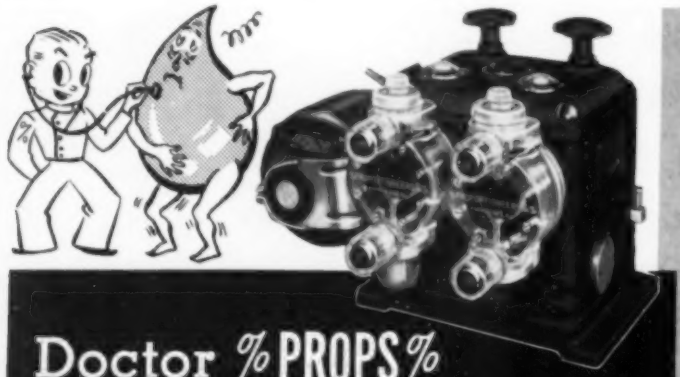
Worthington Pump and Machinery Corporation—A 16-page bulletin, No. S-500 B45, describes the Worthington gas-diesel engine which incorporates the dual plunger pump and the automatic thermal air control.

49 ECHO DEPTH RECORDER

Bludworth Marine, Div. of National-Simplex-Bludworth, Inc.—A specification sheet describing Model ES-123 Supersonic Echo Depth Recorder is offered. This instrument provides a permanently recorded graph of underwater contours as well as an indication of the constituency of bottom materials. Underwater survey groups, dredging companies, bridge builders and underwater pipeline companies will find this equipment most interesting.

50 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.



Doctor %PROPS% treats every drop!

Simplicity of design — resulting from the experience gained in more than thirty thousand successful installations — coupled with sound engineering practice has produced %Proportioneers% low cost, easy to install and operate Chemical Feeder. Thousands are accurately and dependably delivering water treating chemicals in almost every country in the world.

FEATURES INCLUDE . . .

- Famous "See-Thru" molded plastic measuring chamber suitable for feeding any water treating chemical.
- Feeding rate adjustable while in operation.
- Built of standardized, low cost, readily available, interchangeable, "in stock" parts.
- Mechanism operates in continuous oil bath requiring oil change but once a year.
- Sold as a complete "Package" including full instructions and operating accessories.

All these features combine to produce unsurpassed economy of chemical feeding whatever your requirements.

%Proportioneers, Inc.% offers you the opportunity of obtaining years of highest accuracy chemical feeding at lowest cost. Write for Bulletin SAN-7. %Proportioneers, Inc.%, 360 Harris Avenue, Providence 1, Rhode Island.

% PROPORTIONEERS, INC. %

Representatives in principal cities of the United States, Canada, Mexico, and other foreign countries

51 ELEVATED STEEL TANKS

Chicago Bridge & Iron Company—has recently issued a 24-page booklet, "Horton Elevated Steel Tanks of Large Capacity," describing the advantages of using large elevated steel tanks to provide gravity pressure in municipal water works systems. It contains detailed information on the design and construction of Horton radial-cone elevated tanks which are built in capacities from 500,000 to 3,000,000 gal and Horton-spheroidal elevated tanks built in sizes from 1,000,000 to 3,000,000 gal. Included in the booklet are twelve photographs of actual installations, a table of sizes, and a page of drawings showing construction details.

52 ELEVATED STEEL TANKS

Pittsburgh-Des Moines Steel Company—Detailed descriptions and data on a complete line of elevated steel tanks for water storage are provided in a 20-page brochure, "Modern Water Storage." The latest obloidal, toro-segmental and radial-cone bottom tanks developed are discussed and comparative performance features given. Tables of dimensions and capacities, standard and accessory tank equipment, specifications and foundation requirements are included, and many illustrations of elevated tank installations are shown.

53 EMERGENCY HYPOCHLORINATOR

%Proportioneers, Inc%.—Bulletin San-8 includes description of dual drive (electric and gasoline) feeder for emergency or standby chlorination service.

54 ENGINEERED TIMBER CONSTRUCTION

Timber Structures, Inc.—has a catalog describing structural properties of heavy timbers and their proper application in modern churches, schools, and commercial and industrial buildings. Particular attention is devoted to glued laminated timbers and their structural values, finishes and appearance grades. Typical installations of girders, beams, purlins and arches are shown, together with tabular data on typical sizes, curvatures and arch sections. Principal types of trusses are illustrated along with common adaptations and essential dimensional data.

55 ENGINEERING INSTRUMENTS

W. & L. E. Gurley—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Description and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

56 ENGINEERING INSTRUMENTS

National Blue Print Company—has a booklet discussing their instrument repair shop where they are prepared to repair, rebuild and refinish optical reading measuring instruments of nationally known makes and models such as W. & L. E. Gurley, Brunson Instrument Co. and David White Co. The company also sells rebuilt transits and levels that have been completely reconditioned.

57 EQUIPMENT

Austin-Western Company—A 12-page catalog, AD-2146, covering the company's line of equipment is available. This includes descriptions and pictures of the various sizes of power graders and their attachments, street sweepers, 3-wheeled and tandem rollers, the Badger convertible shovel and the complete line of crushing, screening and washing equipment.

58 FACILITIES & PRODUCTS

Newport News Shipbuilding & Dry Dock Co.—Illustrations on every one of the 40-pages of this attractive book show some of the company's facilities and products in the process of manufacture. A wide range of facilities as to function, type, and capacity, together with a trained organization, are needed for the building of large compact vessels, producing rayon-yarn-spinning machinery, steel pipe lines, tanks, valves, gates, and a variety of equipment designed especially by the user.

protection. Autopositive reproductions ed in place of those drawings which d otherwise be exposed to constant and tear. These intermediates – with photographic black lines on a durable, paper base – produce sharp blueprints ever needed.

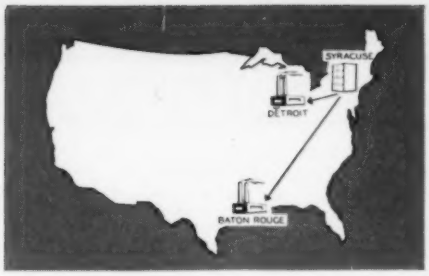


Photo-lasting files. The apparatus and other engineering drawings for Solvay's alkali plants in Syracuse, Detroit, and Baton Rouge – are prepared by the home-office staff in Syracuse, N. Y. Then Autopositive intermediates, which have the lasting qualities of photographs, are made for future reference and print-making requirements.

e Solvay Process Division, Allied Chemical & Dye Corp., reports

New speed and versatility in drawing reproduction ... with Kodagraph Autopositive Paper

Drawing duplication simplified . . . print deliveries speeded . . . new reproduction services provided – these are some of the advantages Solvay Process is realizing with Kodagraph Autopositive Paper.

This new photographic intermediate material reproduces all types of drawings and documents *directly*. In addition, Autopositive increases the utility of existing print-making equipment . . . brings the "plus" features offered by photography alone to many jobs. See how it works for Solvay . . . *see how it can work for you!*

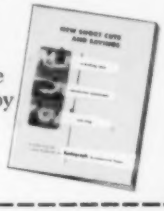
Positive photographic intermediates are produced directly from drawings – no negative step, no darkroom handling. Solvay exposes Autopositive in its blueprint machine . . . processes it in standard photographic solutions.

Plant reports prepared quickly. Autopositive intermediates are used as "masters" from which the required number of direct-process prints are made. These intermediates can easily be revised – deletions made and new detail added – by hand or typewriter – so that the basic form can be used over and over.

tly redrafting eliminated. Old, soiled wings are reproduced on Kodagraph topositive Paper, which intensifies line ail, cleans up backgrounds . . . producing w-quality" print-making masters *with- costly redrafting.*

Contracts expedited. Autopositive intermediates are sent to outside bidders on plant construction projects so that the required number of blueprints needed for quotations can be made. This saves time previously lost when insufficient quantities of prints were supplied.

Get complete details on Kodagraph Autopositive Paper. Write for a free copy of "New Short Cuts and Savings."



Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

93

Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

Name_____ Position_____

Company_____

Street_____

City_____ Zone_____ State_____

Kodak
TRADE-MARK

59 FIELD, LEVEL, AND TRANSIT BOOKS

Wilson Jones Co.—has a circular describing a broad line of field, level, transit, topographical, and cross section books. Forms are lithographed on water repellent paper. There are loose leaf and bound book styles. Ask for Circular D-1115.

Order Your Literature Now by mailing the coupon on page 94 to CIVIL ENGINEERING.

60 FLUORESCENT LAMP BALLASTS

General Electric Co.—Two publications on fluorescent lamp ballasts are available. The first, a 20-page, three-color booklet, GEA-5731, explains in non-technical language how a fluorescent lamp works and the part the ballast plays in its operation. Of a more technical nature, the second publication, GEA-5672, deals with the radical system of "sound-rating" its ballasts. The 4-page, two-color brochure describes how the company's ballasts are classified according to the amount of natural hum they emit. It explains how these ratings can be put to use by fixture manufacturers, electrical contractors, and architects, and gives a typical example of application.

61 FLUORIDATION

%Proportioneers, Inc. %—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

62 FOOTWALKS

Wm. F. Klemp Co.—offers a 1951 edition of their catalog entitled "Klemp Open Steel Grating and Stair Treads, the Perfect Structural Steel Flooring," containing information on riveted and welded grating, structural steel footwalks, bridge decking and drain grating, for use in refineries, power houses, sewerage units, mezzanine storage rooms, catwalks, heavy industries, bridges, etc.

63 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

64 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

65 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

66 GRID ROLLER

Hyster Co.—A 10-page pictorial and verbal description of how, where, and why the grid roller process has proved a better, less expensive and faster way of reclaiming and maintaining bituminous roads is offered.

67 GUNITE

Pressure Concrete Company—has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories, and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and much other data.

68 HEAVY-DUTY PROTECTIVE PAINT

Joseph Dixon Crucible Co.—A 6-page brochure graphically tells the story of protective paints for bridges, tanks and other types of outdoor steel structures. Bulletin V-60 contains a complete outline of the mechanical side of protective paints, pigments, etc. A page of accurate color chips is incorporated for ready reference.

There are 168 Digest items on pages numbered 94 to 114. Read all items for the literature of interest to you.

Hey, buddy, where's the fire?
This is no fire, officer. We're headin' for Kansas City Missouri and the A.W.W.A. Convention.
See you in Kansas City, friends, May 4 to 9. And don't forget to look in on us at Booths 77 and 78.

MATHEWS
HYDRANTS
Made by R. D. Wood Company
Public Ledger Building, Independence Square, Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

69 HIGHWAY MATERIALS

American Association of State Highway Officials—offers a two volume edition, Part I Specifications and Part II Tests. This publication represents the combined knowledge and experience of the American Highway Materials Engineer. It is an accepted handbook in this highly specialized category and is used in every State Highway Department as well as in hundreds of engineering offices, not only in the United States, but throughout the world. The contents cover essentially every material used in the design, construction and operation of a highway department, whether it be rural or urban. Volumes are not sold separately. Price per set $6.00.

N. B. There is a charge for these volumes. Make checks payable to the American Association of State Highway Officials.

70 HOT PROCESS WATER SOFTENERS

Permutit Co.—Bulletin 2341 illustrates and describes new hot process water softeners. This equipment is especially designed to condition boiler feedwater so as to protect tubes and drums against scale and corrosion and inhibit caustic embrittlement.

71 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

72 HYDRAULIC TURBINES

James Leffel & Co.—Two bulletins tell about recent Leffel hydraulic turbine installations. Bulletin 1085 describes the installation at the Bureau of Reclamation's new Anderson Ranch Dam, with photos, statistics, etc. Bulletin 1086 contains information on a turbine used in the expansion of TVA's Wilbur Dam, with photos, field test results, cross-section of installation, etc.

73 HYDROCRANE

Bucyrus-Erie Co.—The two-color, 24-page booklet, "Busy As A Bee" pictorially illustrates the all-hydraulic Hydrocrane's versatility by showing it doing everything from digging ditches to moving furniture through second story windows. Over 100 illustrations show the machine with its many attachments placing tanks and pipe; digging, trenching and backfilling, etc.

74 HYDROLOGIC DATA BOOK

Leupold & Stevens Instruments, Inc.—A completely revised edition puts interpretive data on water measurement and control at your fingertips. Over 150 plates contain information on float wells and instrument shelters, typical installations, a wealth of hydraulic and conversion tables, and information on internationally famous Stevens water measuring instruments. Price is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc..

75 INDUSTRIAL BUILDINGS

Timber Structures, Inc.—A catalog contains construction ideas for several types of wide span buildings suitable for efficient manufacturing and warehousing. It stresses economy and efficiency of glued laminated girders, beams and trusses. Included are data and dimensions helpful to architects and engineers in preliminary planning. It shows pictures and detail drawings of typical installations.

76 INDUSTRIAL LINE

Allis-Chalmers Manufacturing Company—A 28-page general line catalog is a printed product display in three colors of the complete industrial line. Lawler tractors, motor graders, industrial wheel tractors, power units, allied equipment, accessories, and attachments are all included now in one cover. Color illustrations are used throughout the catalog, and brief descriptions and specifications give the highlights of each model in the line.

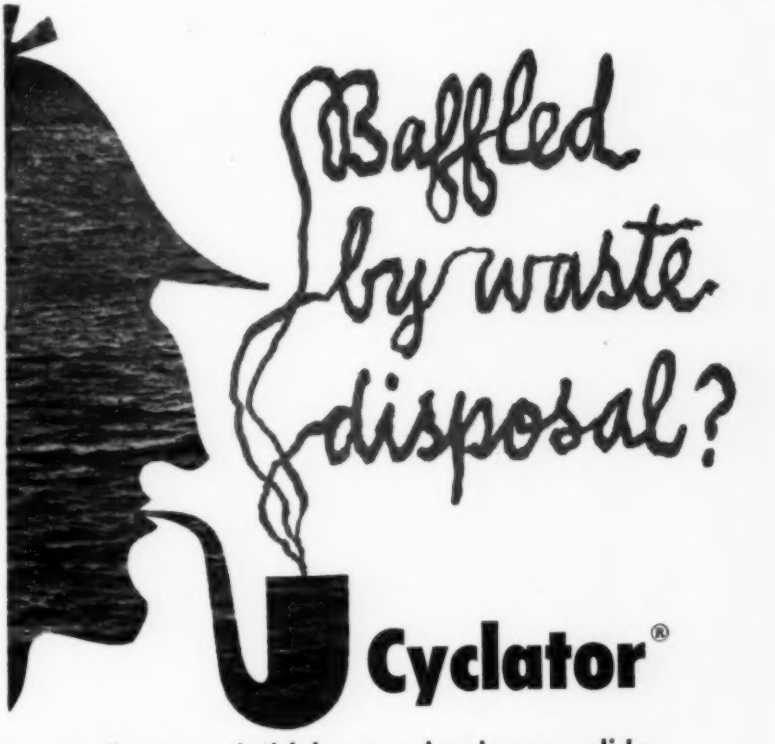
77 INDUSTRIAL PRODUCTS

Johns-Manville—The 40-page catalog contains descriptions, sizes, illustrations, and application data on the following J-M products: "Transite" asbestos-cement pipe, friction materials, packings and gaskets, refractory products, electrical products, asbestos products and industrial building materials.

78 IRON-CLAD CONCRETE FLOOR

Master Builders Co.—A 36-page illustrated booklet gives full information on product and method for producing colored and non-colored iron-armored concrete floors. Masterplate floors are spark-resistant, static-disseminating, non-dusting, non-slip, corrosion-resistant, easy-to-clean and economical. The booklet contains full information on nine features of Masterplate floors, specifications and detailed directions.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!



collects and thickens voluminous solids

Looking for clues for the effective removal of oils, light suspended solids and toxic metals? Then investigate the Cyclator.

The Cyclator combines chemical treatment, solids recirculation and mechanical thickening within a single, compact, space-saving unit for complete treatment of a wide range of industrial wastes. You can count on a pure effluent at low cost—and in many cases—gain substantially by recovering by-products and by the reuse of purified water.

Ask for complete information including Cyclator case histories. Available in our Bulletin 850.

INFILCO

INFILCO INC. *Tucson, Arizona* | *Plants in Chicago & Joliet, Illinois*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste Treating Equipment

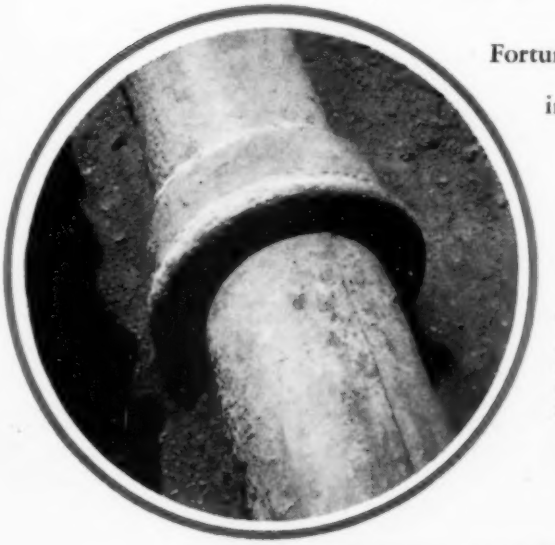
This is the pipe

that's known as the

Taxpayers' Friend

To a tax-burdened public the statement that cast iron pipe is the "taxpayers' friend" is more than a mere figure of speech. To most waterworks engineers it is a cold fact. They know that cast iron pipe in water distribution systems has saved, and continues to save, millions of dollars in local taxes.

The useful life of cast iron pipe is known to be 4 to 5 times the average term of a water revenue bond issue. More than 35 American cities have cast iron mains in service that were installed over 100 years ago. A survey sponsored by three waterworks associations shows that 96% of all six-inch and larger cast iron pipe *ever laid* in 25 representative cities, is still in service.



Fortunately for taxpayers, over 95% of the pipe in America's water distribution systems is long-lived cast iron pipe—*the taxpayers' friend.*

This cast iron water main installed in Richmond, Virginia, 120 years ago, is still in service. Over 35 other cities have century-old cast iron mains in service.

CAST IRON ®

CAST IRON PIPE

America's No. 1 Tax Saver

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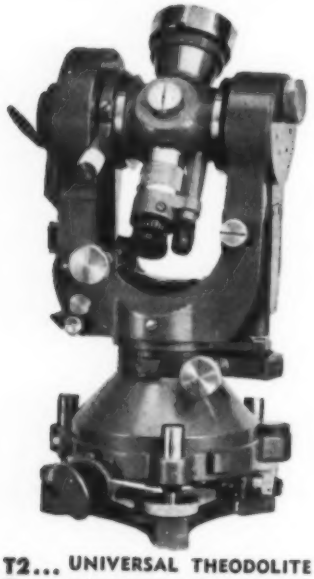
CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.



T2... UNIVERSAL THEODOLITE

The recognized instrument for triangulation, bridgework and other precise engineering jobs... The instrument for you.

You read both circles by microscope direct to 1". Every reading gives the mean of two diametrically opposite points of the circle, therefore free from eccentricity-errors.

Due to the optical plummet, centering above a ground point is easily and quickly done even on windy days. The telescope, with a big field of view, is easy on the eye and can be transited both ways... Choose Wild instruments for ease of operation, speed and accuracy.

For detailed information ask for Booklet CE 4

HENRY WILD

SURVEYING INSTRUMENT SUPPLY CO.
OF AMERICA, INC.

26 COURT ST., BROOKLYN 2, N. Y. TRiangle 5-0644

CATALOG DIGESTS

79 JOINT FILLERS AND SEALS

Servicised Products Corp.—A 12-page catalog gives complete details and specifications on joint fillers, hot poured para-plastic sealing compound, asphalt plank flooring, waterstops, pre-molded para-plastic, kork-pak corrugated closure strips and safety stair treads.

80 LAYKOLD FIBRECOAT

American Bitumuls & Asphalt Company—An illustrated booklet describes Laykold Fibrecoat, a mineral-armored asphalt for cold application, to protect bituminous and metal surfaces.

81 MAINTENANCE & CONSTRUCTION MATERIALS

A. C. Horn Company, Inc.—A 20-page catalog presents a list of A. C. Horn products with the description and use of each. Also, architect's problems and how the company's products have solved them are included.

82 MASONRY AND CONCRETE DIAMOND BLADES

Clipper Manufacturing Company—Metal bonded diamond blades for cutting hard vitreous materials with masonry or concrete saws are described in circular No. 134. Blades are available in bronze, nickel or steel bond and in three rim types for cutting 2 to 3 times faster with smooth effortless results.

83 MASONRY SAWS

Clipper Manufacturing Company—Discover how you can realize four times the profit from a masonry saw with the "convertible" feature. Circular No. 163 illustrates how to cut glazed tile, concrete block, transite, concrete pipe and patches and trenches in concrete slabs.

84 MASONRY UNITS

Waylite Company—A booklet on Waylite, the modern lightweight masonry unit is offered. A description of Waylite, physical characteristics, a section on exterior and interior finishes and sketches on different shapes and sizes of Waylite for every need, are included. There are also construction details for all types of buildings including commercial, industrial and residential.

85 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describes mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

86 MODERN SCHOOLS

Timber Structures, Inc.—The catalog features arch, beam and truss applications for modern, functional school buildings. It illustrates and describes actual installations of classroom, gymnasium, auditorium, vocational shop, multi-purpose school room, portable bleachers and permanent grandstand for athletic fields. Includes drawings of typical connections and tables of dimensions, sizes and weights of various types of trusses, with dimensions of bearings.

87 MOTOR GRADER

Allis-Chalmers Manufacturing Company—A 16-page, two-color catalog on the newest product in the company's line, the AD-40 motor grader with 4-cylinder diesel engine, 104 brake hp, is offered. New features incorporating full visibility for the operator, easy working controls, "hydraguide" steering, and extra high clearance are explained. Large pictures of the AD-40 in action on various jobs show what its many features mean in terms of work it can do.

88 MOTOR OIL

Standard Oil Co. (Indiana)—The booklet entitled "Stanolube HD-M Motor Oil" is a technical description and definition of heavy duty motor oils, illustrating through charts, photographs, and other data its ability to cope successfully with the most difficult problems of lubrication in automotive, diesel and HD engines.

89 OPEN STEEL FLOOR GRATING

A. O. Smith Corp.—A 12-page booklet "The Facts About Open Steel Floor Grating and Industrial Safety," gives information on the exclusive 100 per cent serrated surface grating for flooring, walkways, and stair treads. It is profusely illustrated and includes a grating selection table for uniform or concentrated loads. Comprehensive detail on use of various types of serrated and smooth grating explains advantages over conventional types.

90 OPTICAL POLAR PLANIMETER

Trans-Global Company—An 8-page catalog on the Model 236 optical polar planimeter describes the patent optical tracing ring, zero-setting lever, and enclosed wheel carriage. It discusses planimeter theory with formulas and sample calculations and describes compensating positions, internal pole methods, and use of checking gauge. It gives constructional details, specifications, hints for planimeter care and use. Catalog Pl-1 is illustrated with photos, diagrams and useful reference tables.

91 OUTDOOR LIGHTING

General Electric Co.—Bulletin GEA-3640C, "Outdoor Lighting for Industrial Plants" contains many helpful suggestions for properly lighting plants. Adequate lighting of roadways, loading platforms, parking areas and property lines can easily be obtained with the luminaires and floodlights described.

92 PACKAGED ELECTRIC POWER

General Electric Co.—A 24-page bulletin on packaged electric power for industry's third—and biggest expansion is now available. Designated as bulletin GEA-5600, the publication outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials. The publication also offers a list of 31 other G-E bulletins giving full information on available equipment for industrial power expansion.

93 PAVING HANDBOOK

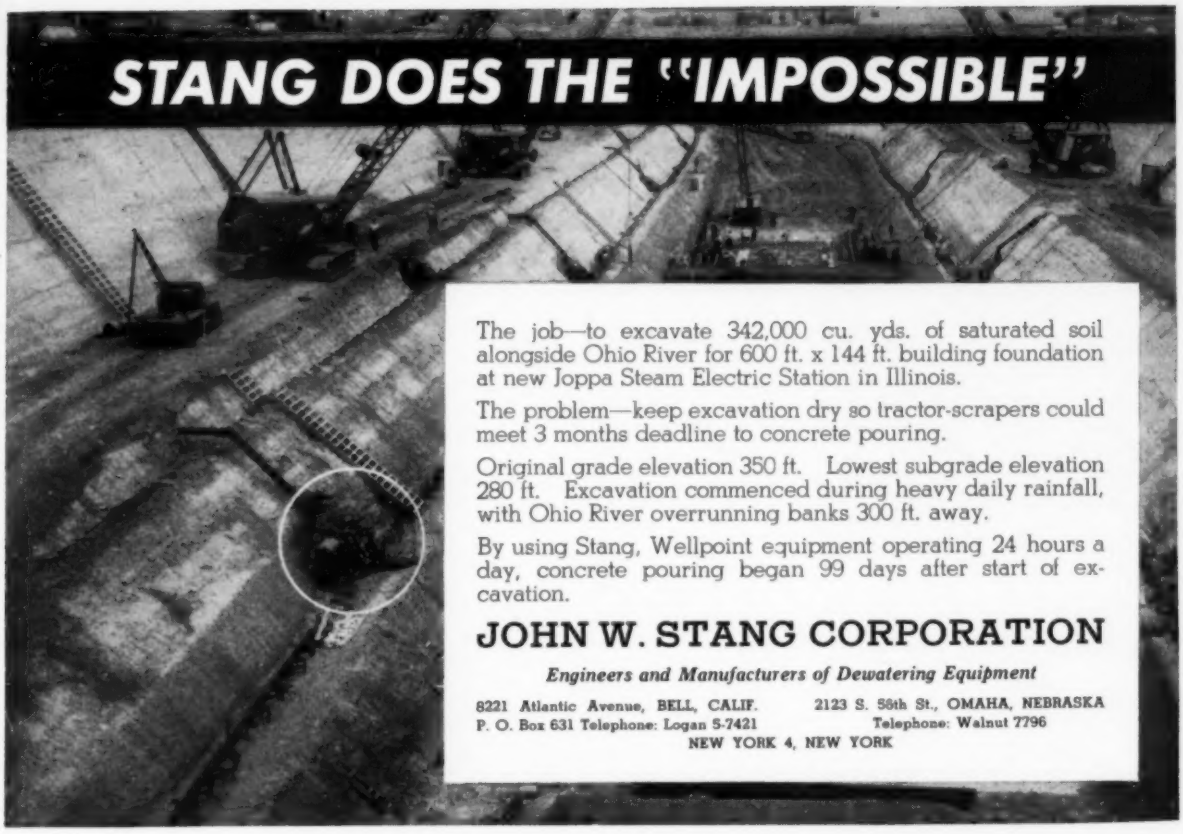
American Bitumuls & Asphalt Company—Complete data for paving jobs, including tables, charts and diagrams, together with full explanation of products used in road and street construction, are provided in this pocket-size handbook.

94 PENCILS

Eberhard Faber Pencil Company—Civil Engineers will welcome the introduction of the Colorbrite high visibility colored pencil fitted with a flat shape adjustable and renewable eraser. Shape of the eraser prevents the pencil from rolling on flat surfaces, and also allows the pencil to be inserted in boot top without slipping. Two colors, red and blue, are available. Lead is of thin diameter, marks are wet-proof and fade-proof. For a free sample of Colorbrite pencil, please specify color.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

STANG DOES THE "IMPOSSIBLE"



The job—to excavate 342,000 cu. yds. of saturated soil alongside Ohio River for 600 ft. x 144 ft. building foundation at new Joppa Steam Electric Station in Illinois.

The problem—keep excavation dry so tractor-scrapers could meet 3 months deadline to concrete pouring.

Original grade elevation 350 ft. Lowest subgrade elevation 280 ft. Excavation commenced during heavy daily rainfall, with Ohio River overrunning banks 300 ft. away.

By using Stang, Wellpoint equipment operating 24 hours a day, concrete pouring began 99 days after start of excavation.

JOHN W. STANG CORPORATION

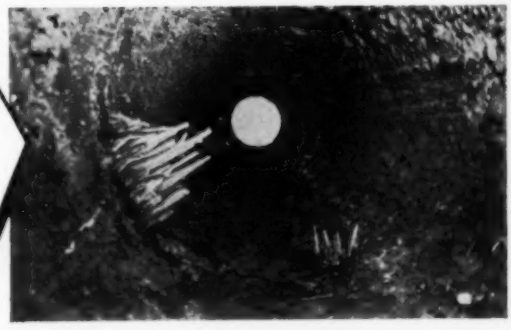
Engineers and Manufacturers of Dewatering Equipment

8221 Atlantic Avenue, BELL, CALIF. — P. O. Box 631 Telephone: Logan 5-7421

2123 S. 58th St., OMAHA, NEBRASKA — Telephone: Walnut 7796

NEW YORK 4, NEW YORK

Are YOU trying to push water through LINES LIKE THIS?



No need to worry about it anymore!

You can recondition your old cast iron or steel line very economically...at much less than the cost of a new pipe line.
AND...*without appreciably disturbing present service!*
Interior tuberculation and incrustation is removed by patented processes used by PIPE LININGS, INC....and a new, continuous, smooth surface cement mortar lining is applied...with only momentary interruption to install by-pass lines.

If your lines look like this ...find out how you can get new pipe performance at much less than the cost of new line. Write TODAY!

CEMENT MORTAR LINING WILL...

Protect against discoloration and contamination
Protect against corrosion
Improve flow coefficients
Prevent leakage
Reduce maintenance costs
Reduce pumping costs

After reconditioning

TATE PROCESS USED on Line 4" to 16"
CENTRILINE PROCESS Used on Line 16" to 144"
Consult our hydraulic engineers ...they are at your service.

PIPE LININGS, Inc.

A subsidiary of
American Pipe and Construction Co.
4675 Firestone Blvd.
South Gate, California
(In the East—CENTRILINE CORP., 140 Cedar St. New York 6, N. Y.)

PIPE LININGS, INC.
4675 Firestone Blvd., South Gate, Calif.
Please send complete information on how we can obtain new pipe line performance from our old line.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

White Universal Level-Transit...

the most versatile instrument you can own!

YES, the White "Universal" Level-Transit is the most practical, complete instrument on the market. Now available in a new improved model — the No. 3000 — with internal focusing, coated optics, guarded vertical arc. In fact, every feature to assure you lifetime durability and accuracy. And the price is *only $185**, complete with tripod. See your dealer, or write DAVID WHITE COMPANY, 359 W. Court Street, Milwaukee 12, Wisconsin.

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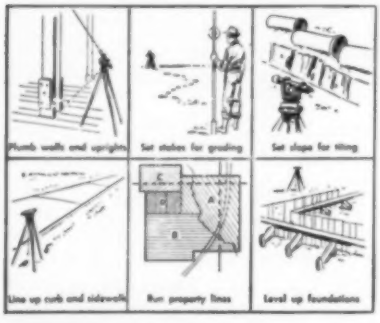

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We offer the most expert REPAIR SERVICE on all makes, all types of instruments.

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CATALOG DIGESTS

95 PENCIL SKETCHING

American Lead Pencil Co.—24 pages of helpful illustrated instructions on pencil sketching. Only 25¢ with two free Venus drawing pencils.

N. B. There is a charge for this book. Make checks payable to the American Lead Pencil Co.

96 PILES

MacArthur Concrete Pile Company—A 4-page folder presents the general description of the various types of MacArthur foundation piles and company engineering services available. Also available, a semi-technical 4-page folder for file reference: "Planned Foundation Filing for Foundation Construction." It presents the technical reason for the use of various types of available foundation piling.

97 PILES

Raymond Concrete Pile Company—Raymond Standard and Step-Tapered Piles are described in literature which also includes information on the scope of Raymond's activities which cover every recognized type of pile foundation including cast-in-place concrete, precast concrete, composite, wood and concrete, steel, pipe, and wood. Raymond's activities and experience also include the construction of caissons and construction involving shore protection, shipbuilding facilities, and harbor and river developments.

98 PILES AND CAISSONS

Western Foundation Corp.—An 8-page bulletin on concrete piles and caissons is offered. Services performed by Western Foundation are enumerated and seven types of cast-in-place concrete piles such as: the button bottom, concrete pedestal, compressed concrete, and wood composite, are outlined in the catalog.

99 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—has descriptive information and engineering data on Monotube steel piles. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: easy handling, speedy driving, economical field extendability, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

100 PIPE CEMENT LINING

Centriline Corp.—A booklet describes the method of reconditioning pipe lines in place by placing a cement mortar lining on the inside surface which will stop leaks, corrosion and increases flow coefficients. This work can be done in pipe diameters from 4 in. to 144 in. with a minimum interruption of service.

101 PIPE GUIDE

Naylor Pipe Company—Bulletin No. 507 presents specifications on light-weight pipe, standard fittings, flanges and connections in sizes from 4 in. to 30 in. in diameter for specified service in construction, dredging, materials handling, mining, oil, paper, power plant and sewage disposal fields.

102 PIPE LININGS

Pipe Linings, Inc.—"Tate Process," a 10-page, illustrated, multicolor bulletin covers a method of lining smaller diameter water, oil, or gas pipe lines "in place." The service cleans corroded matter and tubercules from pipe walls and applies smooth cement-mortar lining.

103 PIPE SYSTEMS

Albert Pipe Supply Co., Inc.—An 8-page illustrated brochure describes "packaged" pipe line for temporary and semi-permanent air, gas and water lines, with emphasis on its use for civilian defense. The system is lightweight, portable, easily assembled and available for prompt shipment. It includes pipe, couplings, fittings, adapters and valves where necessary.

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Layne points with pride to a recent deep well and four vertical turbine pump installation for the city of Wauwatosa, Wisconsin. From an overall capacity, control flexibility, high efficiency, smoothness of operation and modern engineering, this is one of the very finest water supply plants in the state. The 1750 foot deep well, cement grouted from top to bottom, produces 1650 gallons of water per minute against a dynamic head of 145 feet. All water for the city of Wauwatosa is 100 percent from Layne pumps.

This installation is typical of Layne's all inclusive services. Everything from the original test borings to the well drilling, sand screen and pumps and motors, was handled complete by Layne's own crews operating under the direct supervision of Layne engineers. It is such splendid services and outstanding results that Layne and Layne alone in the Nation is in a position to offer cities, factories, mills and plants of all kinds whether the need is for a single-unit or for many. For late catalogs, bulletins etc., address

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General Offices, Memphis 8, Tenn.

Layne

WATER WELLS
VERTICAL TURBINE PUMPS
WATER TREATMENT

CATALOG DIGESTS

104 PIT CAST PIPE

Warren Foundry & Pipe Corp.—offers A.S.A. Standard Specifications for pit cast pipe for water and other liquids, Specification A 21.2–1939.

105 PITOT EQUIPMENT

Simplex Valve & Meter Co.—Bulletin No. 1300 is a complete publication on the choice and use of Pitot equipment. Descriptive material covers instructions for use of Simplex Pitot tube and manometer, instructions for operation and use of Simplex portable Pitot recorder and in addition, contains an entire section applied to theory, formulas, notations, tables and curves relating to Pitot tubes, manometers and recorders.

106 POCKET INSTRUMENTS

Keuffel & Esser Co.—A leaflet entitled, "Right Angles with Pocket Instruments," will be of interest to engineers, builders, etc. Such instruments as the right angle prism, the right angle mirror and the double right angle prism are described, and figures and illustrations show how the instruments are used.

107 POWER GRADERS

Austin-Western Co.—A 24-page catalog AD-2112 pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

108 PRECIPITATOR

Permutit Co.—Bulletin 2204A describes the Permutit precipitator which offers a new and more efficient means for removing impurities from water by precipitation, absorption, settling and upward filtration.

109 PRECISE LEVEL

Henry Wild Surveying Instruments Supply Co.—An illustrated booklet gives full details on the engineer's tilting level which features the famous Wild coincidence prism system for centering the level bubble to an accuracy of 1 in. along the line of sight. For the adjustment of tilting error, no backsight is needed. Tubular level and telescope are rotatable about the optical axis and by centering the level bubble in positions left and right and taking two rod readings, any tilting error is checked quickly and easily.

110 PRECISION-BUILT CEMENT FLOORS

Kalman Floor Company, Inc.—An illustrated 8-page catalog describes the Kalman process, a precision method of building in maximum hardness and density uniformly over complete floor areas. The laying of one of these granolithic cement floors in a typical plant shows in detail the underslab preparation, preparation of proper-aggregate Kalman topping mix, absorption control, compacting, surfacing, troweling and curing.

111 PRECISION LEVELS

Trans-Global Company—A 6-page folder gives photos and specifications of: F/S precision level Model 5165, with split-bubble reading, 180 deg reversion sleeve, minute-reading horizontal circle, and levelling accuracy of .012 ft per mile; F/S normal level Model 5155, with vertical-projection bubble, minute-reading horizontal circle, and levelling accuracy of .03 ft per mile; F/S quick levels Model 5197, with 6 min horizontal circle; and Model 5191, both with vertical-projection bubble

When ordering literature for which there is a charge, please make checks payable to the company offering the material!

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The decision the owners made was a wise one, for Koppers timber is pressure-treated to resist decay and attack from insects — to give *decades* of dependable service, thereby cutting maintenance and replacement costs to a minimum. Further, it has a warm, rich color that blends harmoniously with natural surroundings.

Koppers, by chemical impregnation, can change the characteristics of wood to suit your special needs—can even make it fire retardant.

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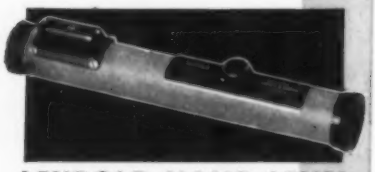

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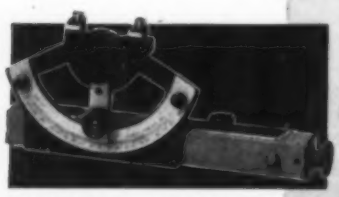

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CATALOG DIGESTS

112 PRESSURE-CREOSOTED PILES

Koppers Co.—A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

113 PRESSURE GROUTING INFORMATION

Gardner-Denver Co.—offers Bulletin P-60 on pressure grouting information. Construction details of the Duplex high pressure steam pumps for grouting service, stationary air compressors, and hand held drills are given, and are supplemented with charts, diagrams and illustrations and other informative matter.

114 PROCESS OILS

Borne, Scrymser Company—has a brochure listing their principal products which may be segregated into two main classifications; process oils and industrial lubricating oils and greases. There is a separate section on recommendations for lubricating oils and greases and one on the use and application of industrial process oils.

115 PUMPS

Economy Pumps, Inc.—A 448-page data book, 4⅜ in. by 8¾ in., with flexible binding, contains general information on centrifugal pumps, principles of pump engineering, general engineering data and selection tables on centrifugal, axial and mixed flow pumps. This book is priced at $3.00.

N. B. There is a charge for this book. Make checks payable to Economy Pumps, Inc.

116 PUMPS

A. O. Smith Corp.—Three bulletins are offered on various types of pumps of varying capacities. Features such as fabricated all steel head and the especially designed Smith built motors are explained. The bulletins are completely illustrated and include details of component parts and design and construction features which insure long life and operating economy. Capacities described range from 50 to 5000 gpm.

117 RACK RAKE

Newport News Shipbuilding & Dry Dock Co.—has an illustrated 15-page booklet which outlines uses for the mechanical rack rake, a power operated rake for cleaning trash racks at water intakes for hydroelectric plants, steam plants, pumping stations, canals, and similar installations. Included in the booklet are drawings for a number of typical installation arrangements.

118 RECTANGULAR STEEL FLOORING

Kerlow Steel Flooring Co.—An informative folder is complete with illustrations, blueprints, charts and descriptive matter on the strongest steel bridge flooring that Kerlow has ever made. IQ-35 is made with grating parallel with traffic and also transverse to traffic.

119 REPRODUCTION MATERIALS

Eastman Kodak Company—offers "Modern Drawing and Document Reproduction with Kodagraph Reproduction Materials." This booklet provides complete information on all types of Kodagraph reproduction materials for use with blueprint and direct-process machines and vacuum frames, for use with contact photocopy equipment, for use with enlargers, projection prints, and process cameras plus information about Kodagraph chemicals, Kodagraph microfile equipment and other Kodagraph equipment.

120 SCRAPER

Bucyrus-Erie Co.—A two-color bulletin explains and illustrates the advantages of the B-113 scraper. Designed to utilize fully the speed and power of the International TD-18A tractor, the B-113 features push bumper adjustable to eight positions, apron grills giving the operator an excellent view of the bowl during loading, "fountain" action for bigger, more uniform loads, fast hauling and clean dumping.

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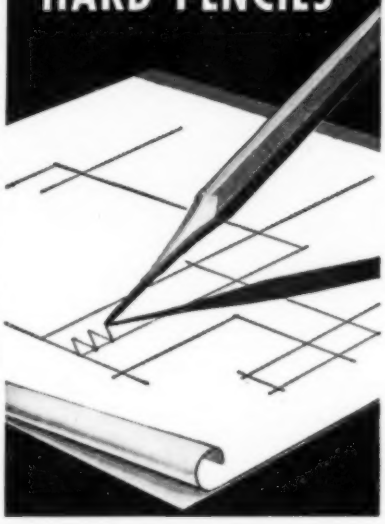

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CATALOG DIGESTS

121 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

122 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 002. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment air inlet and air release valves.

123 STEEL BEARING PILES

United States Steel Co.—A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past uses and applications.

124 STEEL FLOORING INSTRUCTIONS

Wm. F. Klemp Co.—offers its 1951 edition of a technical manual entitled "Instructions for Laying Klemp Hexteel and Floor-steel." Hexteel heavy duty surface armor is an open-steel grid, solid, enduring and self-anchoring. Floor-steel flexible floor armor is an open-steel mat. Both are used to armor and reinforce bridges, docks, air landing strips, loading platforms, industrial floors, heavily traveled highways and catalytic cracking units. The book contains complete engineering data.

125 STEEL SHEET PILING

The L. B. Foster Company—An 8-page illustrated brochure listing advantages of renting steel sheet piling and giving engineering details of interlocking sections has been prepared. Bulletin F-160 contains specifications for piling sections, as well as corners and connections, of the three leading manufacturers of steel sheet piling. Data is also given on pile hammers and extractors available through Foster.

126 STEEL SHEET PILING

United States Steel Co.—A 56-page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections; the straight web, the arch web, and Z-piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

127 STRUCTURAL SHAPES

United States Steel Co.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate-size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails, and corrugated sheets.

Please remember industrial literature is costly. It is requested that you ask only for those booklets of particular interest to you.

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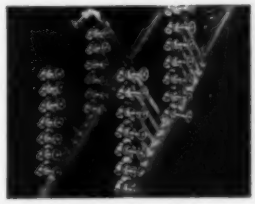

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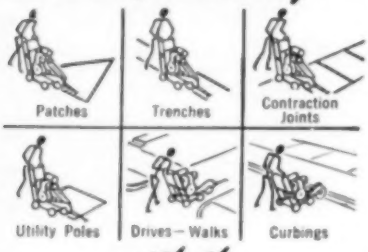

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CATALOG DIGESTS

128 SUMP SEWAGE PUMPS

Worthington Pump and Machinery Corporation—A 4-page bulletin, No. W-317-B12, describes Worthington types FLJ and FLJD wet-pit pumps used in handling sump sewage and for drainage service.

129 SURVEYING INSTRUMENTS

David White Company—offers Bulletin 1052 on surveying instruments for all purposes. The present edition tells the story of the most recent changes and developments in the field of surveying instruments and engineer's field supplies. The catalog presents an exceptionally large assortment of high-grade and up-to-the-minute products.

130 TECHNICAL BOOKS

John Wiley & Sons, Inc.—Information on authoritative, up-to-date technical books in all branches of science and engineering is available in the Wiley general catalog. Of particular interest to civil engineers are the descriptions of standard reference and textbooks on structural engineering, foundations, hydraulic and hydroelectric engineering, municipal engineering, architecture, irrigation, highway and bridge engineering, building construction, and many other related subjects.

131 TECHNICAL DATA CATALOG

Lefax—The 1952 Lefax Catalog contains over 2000 listings of Lefax pocket-size technical books. Each book consists of approximately 140 pages of easily read tables and data in loose leaf form for handy reference right on the job. Subjects listed include: hydraulics, machine design, piping data, surveying tables, metallurgy, analytical chemistry, highway engineering, etc.

132 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

133 TRACING PENCIL TEST KIT

American Lead Pencil Co.—The kit contains samples of Venus tracing pencils for testing on various types of tracing papers. This new pencil contains an active chemical to produce clearer, sharper white or blue prints when reproduction is made from a pencil drawing.

134 TRACK EQUIPMENT

L. B. Foster Company—has a 130-page catalog which simplifies selection and specification of track equipment. It is complete, thorough—contains illustrations and data on all standard track equipment in current use. With this catalog, the most extensive and complex list of materials may be drawn up efficiently and speedily. Rails, angle bars, splice bars, tie plates, bolts and nuts, spikes, frogs, switches—in fact, every track requirement from spikes to bumping posts, is carried in stock.

135 TRACTOR TOOLS

Hyster Company—An attractive, two color catalog, No. 1191, featuring tractor tools for use with Caterpillar-built tractors and equipment has just been issued. The 6-page pictorial and verbal description includes the complete line of tractor tools and graphically shows practical applications of the equipment to multiply tractor uses and increase tractor production.

136 TRACTO-SHOVEL

Allis-Chalmers Manufacturing Company—The HD-5G performs innumerable tasks as pictured on the first pages of a 16-page catalog. Its many attachments render it the most complete unit as described. Hydraulic control, size, ease of handling and method of construction are a few of the subjects covered.

SPECIFICATIONS FOR GENERAL PROVISIONS

A standard preamble and administrative section for all construction specifications and contracts. Prepared by the Construction Committee of the American Association of State Highway Officials in cooperation with the Associated General Contractors of America, Inc., and the American Road Builders Association. These are the men who "know." Collectively they prepare and execute literally thousands of contracts annually. If you are engaged in any form of engineering construction, you cannot afford to be without this new official policy—Price $2.00 per copy.

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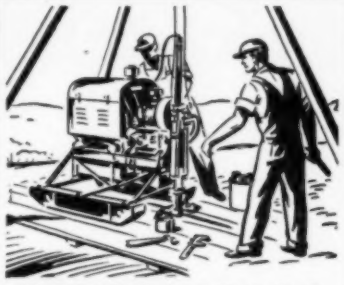
2 - Steel dump barges, mud, 1000 cubic yards, and 1600 cubic yards capacity

1 - Steel oil barge 1920 barrels capacity.

Blanks and information relative to this invitation may be obtained from the above office.



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CATALOG DIGESTS

137 TRANSIT-THEODOLITE

Trans-Global Company—A 16-page catalog on the 6-sec transit-theodolite, Model 4150 R, explains optical plummet, optical reading, and repeating lever. It describes the carrying case, tripod, normal accessories and special accessories. Catalog T-1 covers operating instructions, constructional details, specifications and instrument adjustments and is completely illustrated with photos and diagrams.

138 TUNNELING

Commercial Shearing & Stamping Co.—Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 300 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Commercial Shearing & Stamping Co.

139 UNDERPASSES

Armco Drainage & Metal Products, Inc.—A 16-page booklet, "Manual of Underpasses, Tunnels and Conduits," describes the safety, convenience and economy of these structures. It covers various types of corrugated metal structures, sizes and shapes, and illustrates typical applications. Useful tables are included, also data on underpasses for pedestrians and livestock, conveyance tunnels, service tunnels and conduits. Other sections describe methods of obtaining openings, field construction service, and finishing and equipping.

140 VENTURI METER

Simplex Valve & Meter Co.—Bulletin No. 401 describes in detail the operation and installation methods of the type H meter register. This is a circular-type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

141 VERTICAL PROPELLER PUMPS

Worthington Pump and Machinery Corporation—A 4-page bulletin No. W-314-B2, describes the Worthington type KJA propeller pump used in flood control, drainage irrigation and for similar low head services.

142 VIBRATORS

Viber Co.—New applications and equipment development on interchangeable vibrator units, flexible drive, full depth internal concrete paving, rubber-tipped and Model PX-6 external vibrators are described in a recently published catalog. Specifications concerning speeds, weights, sizes, types of power, etc., are included.

143 WALL-FORM CONSTRUCTION

Symons Clamp & Mfg. Co.—A 34-page catalog on a system of wall-form construction is available. Illustrations show in detail how simply and easily the forming system operates. Actual jobs where Symons forms have been used are well illustrated—showing the forms in use as well as completed foundations. Also blue print illustrations and complete specifications are given—material and equipment necessary, time required and cost figures on actual jobs. The manufacturer advises that, by sending in plans and specifications, you will be furnished a free form layout of your job without charge or obligation.

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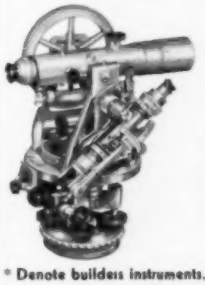

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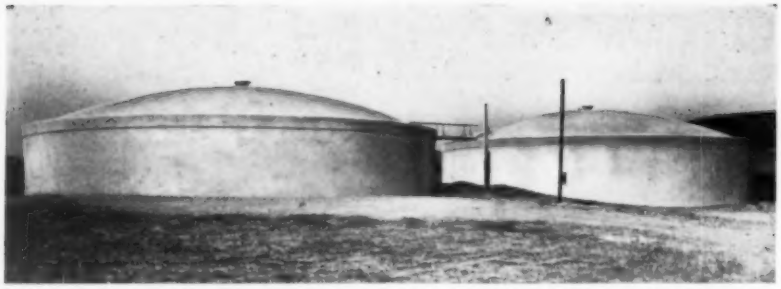

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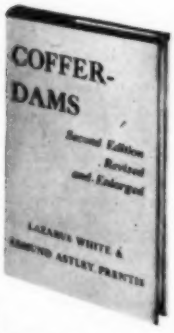

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CATALOG DIGESTS

144 WALL FORMS

Symons Clamp & Mfg. Co.—An 8-page booklet describes and illustrates the latest development in the Symons Forming System. Now brace plates can be furnished for use on 2 by 4 in. braces and can later be used as horizontal supports on scaffolds. The horizontal support is connected to the vertical 2 by 4 in. by a scaffold clamp which eliminates nailing and saves lumber. Many other features of the forms are described in the comprehensive booklet.

145 WALL FORMS

Symons Clamp & Mfg. Co.—offers an 8-page revised Directions Booklet on Symons wall forms. Complete details are given for the erection of the forms including panel alignment, stripping, spacing of ties, safe work load for ties and pressure per square foot that the forms will stand. Complete illustrated information on the many accessories is also included.

146 WASTE TREATMENT

Infilco Inc.—"Waste Treatment to Comply with Stream Pollution Control Regulations" is the title of Bulletin 70-A, explaining the "how" techniques of chemical, biological, and anaerobic waste treatment. It gives case histories and data of value to those responsible for waste treatment.

147 WATER AND SEWAGE PLANT EQUIPMENT

Infilco Inc.—Equipment for municipal water and sewage plants is covered in Bulletin 60-C, just recently revised. It includes the latest equipment available for efficient, economical water conditioning and sewage treatment.

148 WATER CONDITIONING

The Permutit Company—Pocket-size Data Book No. 2478A is compiled for the convenience of practicing engineers and those who work with water conditioning problems. The 102 pages of invaluable data is bound together in a leatherette cover and gold stamped.

149 WATER CONDITIONING UNIT

Infilco Inc.—offers Bulletin 1825 which has 28 pages of information on historical development, distinguishing characteristics, advantages, design considerations, operation, and applications of the Accelator water conditioning unit. Diagrams clearly explain the Accelator and show typical layouts.

150 WATER FILTERS

Proportioneers, Inc.—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems, are given.

151 WATER POWER EQUIPMENT

Newport News Shipbuilding & Dry Dock Co.—An exceptionally attractive book, consisting of 75 pages is offered free of charge to engineers interested in hydraulic turbines, butterfly valves, pressure regulators, penstocks, regulating gates and trash rakes. The booklet shows various plants throughout the United States using this equipment. Pictures, details of the development, sectional views, and an interesting synopsis of the company's hydraulic laboratory are included.

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Fig. B-144-A

One of Two 48" Type M Gates installed in Ft. Stanton Park Reservoir, Washington, D. C., to maintain direction of flow. See Feb. 22, 1944, issue Engineering News Record for story about this project.

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CATALOG DIGESTS

152 WATERPROOFING

Western Waterproofing Co.—A well illustrated folder explains the most effective methods of protecting masonry walls from water damage and dampness, by the "parge" system for interior surfaces and their application of "dilato" expanding mortar to exterior joints.

153 WATERPROOFING

Western Waterproofing Co.—A 4-page folder shows how Western has successfully added years to the life of a wide variety of school and university buildings through weather and water-damage protection, building and concrete restoration, tuckpointing and building cleaning.

154 WATERPROOFING

Western Waterproofing Co.—has a comprehensive guide showing how to protect both new and old structures from: above-grade water penetration with Resto-Crete system and Dilato expanding mortar; interior wall dampness with Parge coat; sub-surface water seepage with Ironite. Detailed data and sample specifications for these services are included.

155 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—A folder shows how the company's complete and highly specialized services have restored, beautified and protected from deterioration a wide variety of churches in all parts of the country.

156 WATER PURIFICATION

Worthington Pump and Machinery Corporation—A 6-page bulletin, No. W-212 B4, describes the operation of a Worthington ion exchange water purification system, and illustrates the equipment furnished for the process.

157 WATER SUPPLY PROGRAM

General Electric Co.—A 40-page, illustrated manual which offers water works superintendents, municipal officials, and other civic leaders a sound, experience-tested program for maintaining public support for water works projects affecting their communities is available. "Good Water and Plenty of It" spells out how long-range water works plans pay off, how to interpret such plans to the public, how public support has been won for water-supply projects, and how dividends can be paid by a sound foundation of public support.

158 WELDED FABRIC

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—A 2-color folder describes Clinton electrically welded fabric which has been successfully applied to every form of reinforced concrete construction. Some of its many uses are for concrete roads, streets, airports, floors, pipe, sewers and reservoirs. Structural advantages, ease of use and standard styles are listed.

159 WELDED STRUCTURES

Lincoln Electric Company—offers a series of case studies of modern welded structures which exemplify the best in welded design fundamentals. The current study is a review of six recently erected welded buildings ranging from office buildings to apartment houses. Other studies recently presented include a 5 span, 480 ft highway bridge; a study of welded joint details and the rigid frame design.

160 WELLPOINT DEWATERING

Complete Machinery and Equipment Company—has a catalog entitled, "Dewatering the 'Complete' Way." The catalog has been published for the sole purpose of showing the ease of installation, operation and maintenance of "Complete" wellpoint systems. Included in the catalog are many pictures of dewatered construction areas where construction "in the dry" has been accomplished as well as diagrammatic sketches of proper location of wellpoint equipment to handle sub-surface water on various types of construction projects.

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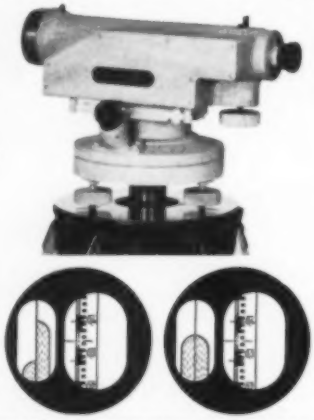

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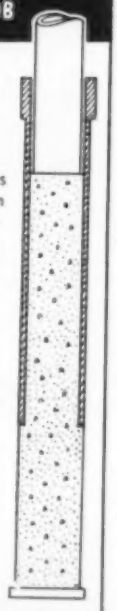

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CATALOG DIGESTS

161 WELLPOINT DEWATERING SYSTEM

John W. Stang Corp.—A catalog describes the component parts of the Stang wellpoint dewatering system; its planning, engineering and various methods of installation. Specific installations on dams, power houses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

162 WELLPOINT SYSTEM

Griffin Wellpoint Corporation—has a comprehensive practical test published to meet requests for a digest of the basic principles of wellpoint systems and their application to dewatering wet excavations. The components of a wellpoint system and the fundamentals of planning, installing and operating the system are discussed and illustrated in detail. There is a charge of $1.50 per copy.

N. B. Booklet free to Contractors & Engrs. if requested on letterhead and directed to Griffin Wellpoint Corp., 881 E. 141 St., New York.

163 WELLPOINT SYSTEM

Griffin Wellpoint Corporation—Photographs and line drawings in "Griffin Pointed Wellpoint Facts" describe typical wellpoint layouts and case histories. Griffin Lits and various assemblies are also illustrated. Several pages are devoted to jetting pumps because the smaller pressure pumps are necessary to install the wellpoints. The larger units are used for jetting piles, sheeting, caissons and other jetting purposes.

164 WELLPOINT SYSTEM

Moretrench Corp.—"Working in the Dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on-the-job photos.

165 WELLS & PUMPS

Layne & Bowler, Inc.—has two interesting and helpful booklets. One, "Well Water Systems" has 48-pages illustrated with many installations of Layne wells and water supply units, underreamed gravel wall wells, sand screen, water treatment and much helpful engineering data. The other is on "Short Coupled Service Pumps" for use as line boosters, cooling towers, spray ponds, river intake or re-lift of any kind regardless of size or capacity needed.

166 WIRE ROPE

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—The new Wickwire rope catalog offers a different approach to this difficult subject. Charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog covers the characteristics, care, handling and describes wire rope for specific industries.

167 WIRE ROPE—LIFE AND COSTS

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

168 WOOD AND STEEL FORM

The Irvington Form & Tank Corp.—A new type of form just placed on the market is fully described in a 4-page circular. The circular describes the accessories and also illustrates several jobs in which the form has been used. Atlas Compo Form has many new features which help to reduce erection and stripping time to a minimum.

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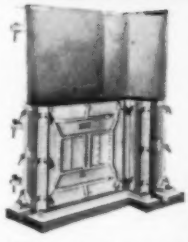

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Summarized in Earlier Issues

100. Forced Vibrations of Continuous Beams, by Edward Saibel and Elio D'Appolonia.

101. Application of Highway Capacity Research, by J. P. Buckley.

102. Utilization of Ground Water in California, by T. Russel Simpson.

103. Pile Foundations for Large Towers on Permafrost, by L. A. Nees.

104. Redesign of Major Airport Terminals, by Herbert H. Howell.

105. Principles of Highway Capacity Research, by O. K. Normann.

D-37. Discussion of Paper, **Design of Prestressed Tanks,** by J. M. Crom.

D-47. Discussion of Paper, **Operation and Maintenance of Irrigation Systems,** by Raymond A. Hill.

106. Analysis of Ground Water Lowering Adjacent to Open Water, by Stuart B. Avery, Jr.

107. Characteristics of the Solitary Wave, by James W. Daily and Samuel C. Stephan, Jr.

108. Control of Embankment Material by Laboratory Testing, by F. C. Walker and W. G. Holtz.

109. Final Foundation Treatment at Hoover Dam, by A. Warren Simonds.

110. Review of Flood Frequency Methods, final report of the Subcommittee of the ASCE Joint Division Committee on Floods.

111. Research in Water Spreading, by Dean C. Muckel.

D-49. Discussion of Paper, **Large Hyperbolic Functions Computed by Fission,** by F. T. Llewellyn.

D-54. Discussion of Paper, **Truss Deflections by the Coordinate Method,** by Kuang-Han Chu. In Proceedings-Separate No. 54.

D-61. Discussion of Paper, **Structural Damping in Suspension Bridges,** by the late Friedrich Bleich and L. W. Teller.

112. Diversions from Alluvial Streams, by C. P. Lindner.

113. Wave Forces on Breakwaters, by Robert Y. Hudson.

114. Utilization of Underground Storage Reservoirs, by Harvey O. Banks.

D-51. Discussion of Paper, **Laterally Loaded Plane Structures and Structures Curved in Space,** by Frank Baron and James P. Michalos.

D-57. Discussion of Paper, **Design of Irrigation Systems,** by W. H. Nalder.

D-60. Discussion of Paper, **Surveying and Mapping Requirements for Modern City Planning,** by Charles A. Blessing.

D-62. Discussion of Paper, **The New Towns Program in Great Britain,** by T. C. Coote.

Third Notice

115. Lake Michigan Erosion Studies, by John R. Hardin and William H. Booth, Jr.

116. Graphical Solution of Hydraulic Problems, by Kenneth E. Sorensen.

117. Development of Stresses in Shasta Dam, by Jerome M. Raphael.

118. Flocculation Phenomena in Turbid Water Clarification, by Harvey F. Ludwig, W. F. Langelier, and Russel G. Ludwig.

D-56. Discussion of paper, **Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels,** by Hassan M. Ismail.

D-70. Discussion of **Regime Theory for Self-Formed Sediment-Bearing Channels,** by T. Blench.

Second Notice

119. Thin-Walled Members in Combined Torsion and Flexures, by Warner Lansing. The performance of thin-walled open section bars subjected to eccentric transverse loads is analyzed by Goodier's bar theory. Calculations are

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1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

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5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

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120. **Surface Water Wave Theories,** by Martin A. Mason. This paper presents for the first time in engineering literature a summary of the information required by engineers to solve problems involving ordinary wave action on structures, such as dams, submerged pipe lines, piles, breakwaters, and jetties. Transportation of material by waves is discussed and methods of predicting wave action are presented. Many formulas, charts, and graphs prepared for the use of practicing engineers are included. An extensive selected bibliography is supplied for the use of those requiring more detailed information. (Available April 1.)

121. **Rate of Change of Grade per Station,** by Clarence J. Brownell. The purpose of this paper is to urge the adoption of a method of describing vertical curves which will give an immediate impression of the sharpness of such a curve. The method explained herein provides a convenient tool for the solution of problems in vertical alinement that can otherwise be determined by trial and error. In the coming era of divided highways and on-and-off ramps, this tool will be found most convenient. (Available April 1.)

122. **Engineering Aspects of Diffraction and Refraction,** by J. W. Johnson. The design, construction, and operation of many coastal engineering works is considerably dependent on the principles of wave refraction and diffraction. This paper discusses the principles that enable the engineer to estimate the "design" wave conditions at specified points on a shoreline. The phenomena of refraction and diffraction are discussed in connection with practical solution of shoreline problems. (Available April 1.)

D-59. Discussion of Paper, **Limit Design of Beams and Frames,** by H. J. Greenberg and W. Prager. Statically indeterminate beams or frames were analyzed by limit design, in this paper, published in February, 1951. Discussers are: L. E. Grinter, I. K. Silverman, J. Benjamin, E. P. Popov, A. Hrennikoff, P. S. Symonds, H. Tachu, V. Franciosi, and H. J. Greenberg and W. Prager. (Available April 1.)

D-65. Discussion of paper, **National Topographic Mapping,** by W. E. Wrather. The original paper, published in April, 1951, explained the cooperation of the Geological Survey and federal and state agencies to expediate progress on the national topographic mapping program. Discussers are: Milton O. Schmidt, D. P. Krynine, and W. E. Wrather. (Available April 1.)

D-71. Discussion of Paper, **Rectification of the Papaloapan River in Mexico,** by Reynaldo Schega. The original paper, published in May, 1951, deals with the building of river cutoffs, as forming the initial steps leading to the relief of the lands bordering the Papaloapan River. Discussers are: Leo M. Odom, Samuel Shulits, and Reynaldo Schega. (Available April 1.)

First Notice

123. **Long-Period Waves or Surges in Harbors,** by John H. Carr. This paper reports the results of field and model studies of the sources and characteristics of long-period waves in harbors and analyzes the subjects of basin resonance and water motion induced by the waves. The particular adaptability of models to this type of study is discussed, and examples of the use of models in the design of harbor facilities are given. (Available May 1.)

124. **Influence Lines by Corrections to an Assumed Shape,** by James P. Michalos and Edward N. Wilson. This is a procedure for obtaining influence lines for continuous structures directly from a consideration of geometry. It is applicable to structures of constant or variable section, whether or not subjected to joint translation. Since it is a numerical method involving successive corrections to an assumed shape, the procedure lends itself to precise analytical computations, design studies and development of judgment and sense of scale. (Available May 1.)

125. **Torsion of Plate Girders,** by F. K. Chang and Bruce G. Johnston. Analytical and experimental research was undertaken at Lehigh University, Bethlehem, Pa., to determine the stress distribution stiffness, and strength of bolted, riveted, and welded plate girders under uniform twisting moment. Formulas are proposed for calculating rivet or bolt pitch and size of welds for the bolted, riveted, and welded plate girders. When rivet pitch or weld size is given, the torsional stiffness and strength can be predicted. (Available May 1.)

126. **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock. The flow of air in level, open country is adopted as the standard of reference in this paper, assuming that the influence of local shielding and unusual topography will be evaluated by the designer in each individual case, perhaps with suggestions in the code. Recommendations are based on velocity pressures rather than on design pressures. (Available May 1.)

D-53. Discussion of Paper, **Wedge-Beam Framing,** by Arsham Amirikian. In the original paper, published in January 1951, suggested arrangements of wedge-beam framing are outlined. The range of application is discussed, and a method of analysis is presented. Formulas and tables, as well as a simplified procedure for solution of simultaneous equations, are also given to facilitate the necessary computations in practice. Discussers are: G. C. Ernst, J. J. Hromadik, G. R. Swihart, Herbert A. Sawyer, Jr., J. J. Polivka, and Arsham Amirikian. (Available May 1.)

D-72. Discussion of Paper, **Design of Large Coal Bunkers,** by Paul Rogers. The original paper, published in June 1951, attempts to present a rational design procedure based upon several coal bunkers actually constructed. Formulas for coal pressures on vertical and inclined walls are reviewed and values are tabulated; bunker walls are presented as flexible plates; unbalanced forces due to asymmetry are analysed; and continuity for the stiffeners is introduced. Discussers are: George L. Blanchard, Alexander M. Turitizin, and Paul Rogers. (Available May 1.)

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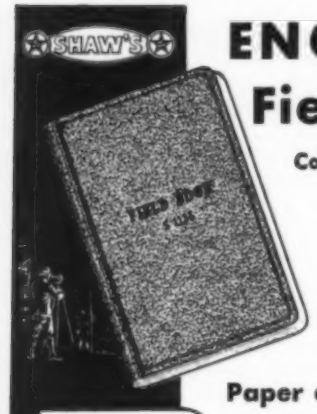

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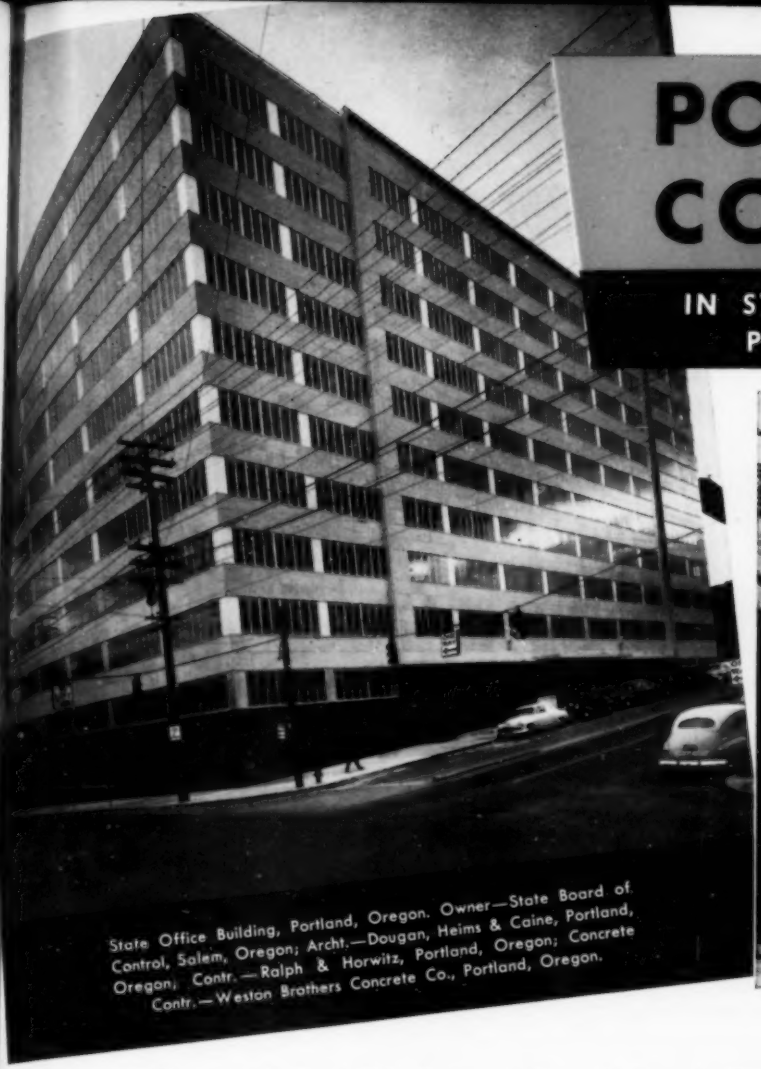


State Office Building, Portland, Oregon. Owner—State Board of Control, Salem, Oregon; Archt.—Dougan, Heims & Caine, Portland, Oregon; Contr.—Ralph & Horwitz, Portland, Oregon; Concrete Contr.—Weston Brothers Concrete Co., Portland, Oregon.

THE increasing use of Pozzolith Concrete in such outstanding structures as the new Oregon State Office Building is indicative of its wide acceptance by leading architects.

Among the advantages of Pozzolith Concrete are:

- Easier Placeability — for lower placing costs
- Minimized Segregation — for better appearance
- Reduced Shrinkage — for less cracking
- Lower Permeability — for less "waterproofing"... later
- Increased Bond-To-Steel — for better construction
- Greater Durability — for lower maintenance costs

Whatever the type of structure — whether commercial or industrial building, public works, bridge, dam or tunnel — Pozzolith produces these benefits *at lower cost than by any other means.*

Full data on Pozzolith and ACI and ASTM procedures for design, specification and production of concrete, on request.

Approximately 10,000,000 Cubic Yards Of Pozzolith Concrete Were Placed In 1951.

OTHER MASTER BUILDERS PRODUCTS IN WHICH CEMENT DISPERSION IS EMPLOYED

EMBECO...
For non-shrink grouting and reintegration.

MASTERPLATE...
For "iron-clad" concrete—industry's toughest floor. Non-colored and 11 colors.

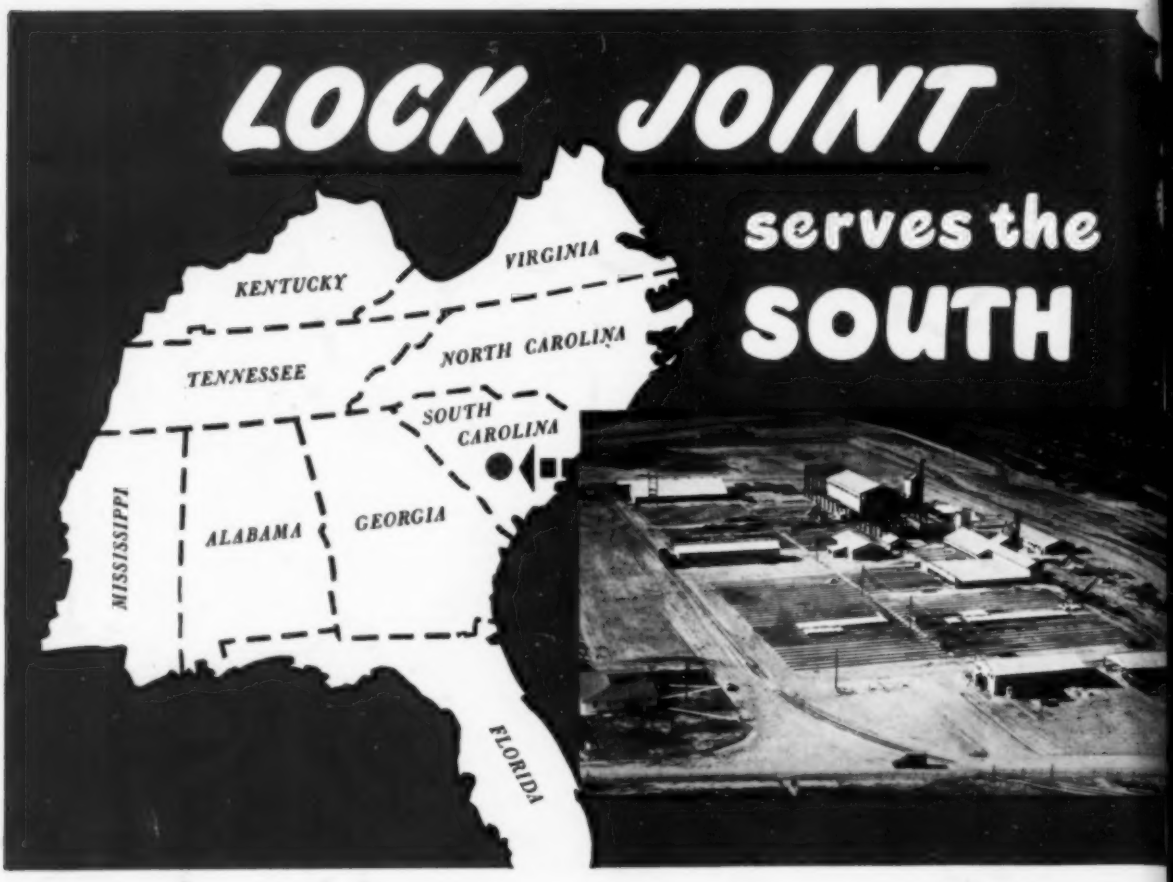
MASTERTEX...
Cement-base paint of low permeability for protecting and decorating exterior and interior surfaces of concrete and masonry.

OMICRON MORTARPROOFING..
For tight brick walls. Provides good workability with 15-20% less water, correct water retentivity. Contains stearate.

the MASTER BUILDERS Co

VELAND 3, OHIO — Subsidiary of American-Marietta Company — TORONTO, ONTARIO

LOCK JOINT serves the SOUTH



IF YOU'RE FROM THE SOUTH . . . **specifically Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Kentucky or Tennessee** . . . our plant at Columbia, South Carolina, is ready and waiting to serve you. This Columbia plant, the fourth of our up-to-date permanent pressure pipe manufacturing yards, is equipped to produce Lock Joint Prestressed Concrete Cylinder Pipe in diameters from 16" to 48", designed for any pressure common to water works practice. The plant's central location in the Southeast makes it possible to deliver the completed pipe speedily and economically throughout this area.

IF YOU'RE FROM ANY OTHER PART OF THE COUNTRY EAST OF THE ROCKIES . . . our three other permanent pressure pipe plants located at Wharton, N. J.; Detroit, Mich.; and Turner, Kansas, stand ready to provide for your complete Reinforced Concrete Pressure Pipe requirements. All these plants are equipped to manufacture the most carefully designed modern Concrete Pressure Pipe in a large range of standard diameters, and have facilities to handle any contract however large or small.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

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LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

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